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ABSTRACT

Contained in this publication is the final report of a panel of experts, convened by the Assistant Director for Science Education of the National Science Foundation, interested in science education for early adolescence. The document also contains three appendices. Appendix A lists members of the panel and their professional affiliation. Appendix B consists of the position papers by the panelists: (1) The Young Adolescent: Informal Learning and the Science Curriculum by Robert D. Barr; (2) Perspectives (Research) and Recommendations for the Science Education Directorate by Diana Baumrind; (3) Early Adolescence and the Science Curriculum by Paul DeHart Hurd; (4) Social Science Education of the Early Adolescent by C. L. Davis; (5) Perceptions (School) Relating to the Education of Adolescents by Fred D. Johnson; (6) Perspectives (Societal) and Recommendations for the Science Education Directorate by Joan S. Lipsitz; (7) Career Education by Barbara Preli; and (8) Strengthening Mathematics Programs for Early Adolescents by Eugene P. Smith. Appendix C presents a literature review of early adolescence and implications for programming. This review consists of three parts: I, The Early Adolescent Learner; II, The Learning Context; and Summary. A 19-page listing of references concludes the review. (PEB)

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Early Adolescence

Perspectives and recommendations

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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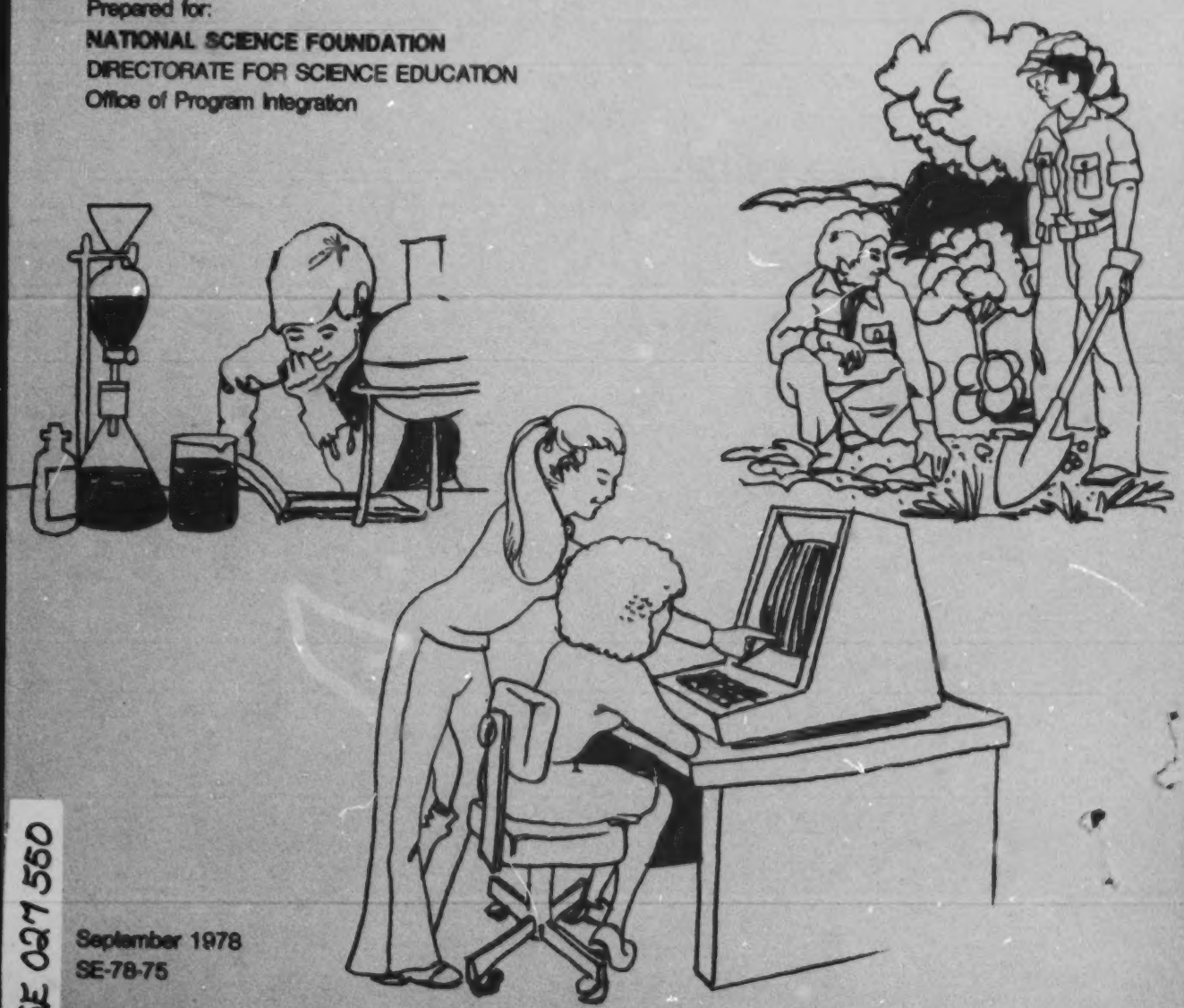

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EARLY ADOLESCENCE

PERSPECTIVES
AND
RECOMMENDATIONS
TO
THE NATIONAL SCIENCE FOUNDATION

Prepared for
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Office of Program Integration
September 1978

Introduction

In response to a directive from the Assistant Director for Science Education, Dr. F. James Rutherford, the Office of Program Integration (OPI) initiated in December 1977, a planning effort in science education for early adolescence. As a part of this effort, OPI assembled a panel of experts on important aspects of early adolescence. Each panelist was asked to: 1) write a short paper outlining his or her perspective on early adolescence and reommendations to the NSF; 2) attend a meeting in early May to discuss these papers and generate a single list of recommendations; 3) review the panel leader's report of the meeting, and 4) review OPI's recommendation and implementation papers. Experts were sought in the following fields: math, science, and social studies curriculum, school management, career education, informal education, societal perspectives, and developmental psychology. In addition, OPI commissioned a research paper on the literature of early adolescence. Reviewing this paper was also a responsibility of the panel experts. This volume presents the panel's final report, the experts' papers, and the literature review.

Based on these papers, and other external and internal considerations, the Directorate for Science Education is currently engaged in developing short and long range program efforts in science education for early adolescence. The emerging recognition that early adolescence is a crucial period in science education, both for the student and the future of science, gives urgency and significance to these efforts.

The Office of Program Integration gratefully acknowledges the contributions of the individual panelists. In particular, OPI appreciates the gracious and highly responsible leadership of Dr. Paul DeHart Hurd and the responsive, conscientious scholarship of Dr. Geneva D. Haertel.

Conrad G. Katzenmeyer
Mary S. Rivkin

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Final

Report of the

National Science Foundation

Early Adolescence Panel Meeting

April 30, May 1, 2, 3, 1978

Sheraton-Park Hotel, Washington, D. C.

Prepared by

Paul DeHart Hurd, Panel Leader

July 1978

This report was prepared for the Science Education Directorate of the National Science Foundation as part of its consideration of current and possible future activities in science education for early adolescence. Any opinions, findings, conclusions or recommendations expressed herein are those of the author and fellow panelists and do not necessarily reflect the views of the National Science Foundation.

Final
Report of the
National Science Foundation
Early Adolescence Panel Meeting
April 30, May 1, 2, 3, 1978

Paul DeHart Hurd, Panel Leader

The Early Adolescence Panel was charged with the responsibility of: 1) reviewing the current situation regarding the education of early adolescents in the subjects of science, social science and mathematics, and 2) exploring ways to improve their education in both formal (school) and informal (out-of-school) contexts. It is becoming increasingly evident that the early adolescents in American society are a forgotten group. Although the life span between the ages of 10 to 15 represents a unique period in human development that is characterized by extensive social, psychological, and biological changes, these attributes are rarely considered in educational practices.

Through careful and systematic discussion panel members first sought to identify the problems, questions, and needs related to improving the education of early adolescents. A second consideration was an agenda for research (normative and empirical), where necessary, to provide a knowledge base for making educational decisions on problems and issues. Rather than signalizing specific priorities for research and development the Panel has opted for a holistic view of early adolescent education and recommends a broad frontal attack toward educational improvement. The panel members (Appendix A) represent a spectrum of insight and experience in working with early adolescents; they include: researchers in adolescent development; curriculum specialists in science, mathematics, and social studies; representatives from school districts; and authorities in career and informal education. Nearly all the panel members were parents adding another measure of expertise to our discussions.

This report of the Early Adolescence Committee is based on 1) a set of position papers (Appendix B) prepared by panel members in advance of the Washington meeting; 2) an open discussion of each paper at the conference and 3) recommendations for policy and actions growing out of panel deliberations. Following the Washington meeting, panel members had the opportunity to revise their position papers and to include additional suggestions for research and development. A first draft of the panel's recommendations and subsequent remarks by individual members was prepared and submitted to each participant to critique. This final report includes the views and reviews of the panel's recommendations for a serious study of early adolescent education in the sciences, social sciences, and mathematics.

This committee report is organized into two sections. The first section lists critical issues related to the education of early adolescents and includes recommendations for actions. In the second section suggestions are made for increasing the knowledge base about early adolescents through research and study. There is an overlap of ideas between the two sections as there is an inherent relationship between educational issues and research needs.

The position papers (Appendix B), written by individual panel members, include in most instances recommendations for research and development as they are perceived in terms of the special interests of the author. The background paper on early adolescence (Appendix C) also includes research and policy recommendations. These are derived from an analysis of the existing research and information and evident gaps in essential knowledge.

This document as a whole offers the beginnings of a framework for the development of improved educational opportunities for the early adolescent. This is seen as an effort to maximize the intellectual and social potential of this age group and to do so in the context of the challenges and changes which now characterize life and living in America.

SECTION I. ISSUES

The Early Adolescent as a Person

Much of what is known about early adolescence has been extrapolated from studies of younger children or from studies of the adolescent. This information is of limited value when we seek to focus on the early adolescent in the developmental continuum. We suspect that this absence of specific information has led teachers and other adults to depend upon stereotypes, folklore, personal experience, and other dubious notions about, Who and what is the early adolescent?

There are two periods in a human life characterized by rapid and extensive changes along multiple developmental structures. One period is the first three years of life and the other is a span time that falls typically between the ages of 10 and 15 years. The second period is distinguished by the complexity of interpersonal changes and the extent of diversity between individuals. The many areas of developmental changes that occur during early adolescence make it a unique and an identifiable age group.

The panel members see the need for the development of a profile model from the information that is now known about early adolescence. The model would include dimensions in such areas as biology, psychology, learning, psycho-emotional, intelligence, interests, attitudes, aspirations, dysfunctions, culture, family relations, etc., etc. There is also need for the collection and organization of extensive demographic information on the early adolescent. Data from Project Talent, and the National Assessment of Educational Progress relative to early adolescence should be explored as well as other sources of relevant information. However, it is already apparent that there is likely to be a deficiency in the knowledge base required for an adequate profile model of early adolescence.

Rationale and Goals

We need a rationale that encompasses the education of the early adolescent. Such a statement targeted on the young adolescent is emerging from teachers and educators involved in the middle school movement. The rationale is not broadly known and a societal consensus has yet to be formed.

What passes for an educational rationale for early adolescence, in a majority of schools, is either abstracted from philosophies governing elementary or high school education, or some mixture of these separate educational units. The uniqueness of early adolescence is not recognized. The development of an appropriate conceptual framework should begin with the cognitive, psycho-social, and biological characteristics of the early adolescent. The rationale should reflect the secular trends which characterize the broad social realities of our times such as, new career patterns, changes in life styles, shifts in family organization and parenting, new concepts of health and wellness, factors of social integration, the changing attributes of the work/leisure relationship, and others. The school curriculum and associated educational resources can be valid only to the extent that they reflect the characteristics of early adolescence and social realities and recognize what knowledge and which skills representing various disciplines are most useful.

The sciences, social sciences, mathematics each have goals that are distinctive for their particular disciplines. There are interdisciplinary goals

that overlap these subject areas and provide for interconnections, such as: 1) reasoning (linear and systemic), logical thought and critical thinking; 2) coping capacities; 3) adapting to change; 4) assuming self-management and responsibility; 5) stimulating career awareness; 6) using knowledge in various contexts; and 7) developing academic and social skills.

The central idea is that educational goals need to be described that are specific for early adolescence.

Critical Thinking

Critical thinking as an educational goal is isolated here to emphasize not only its importance as an outcome of teaching but also to call attention to changing notions of what this goal could mean. Recently there has been an emphasis upon "scientific thinking" or "scientific inquiry" as the ideal or most acceptable form of thinking for scientists and citizens alike. The influence of Piaget's work has led some educators and teachers to expect that formal operational thought is a reasonable objective for most students in the 10-15-year-old age span. Scholarship, research, and experience have brought about a questioning of the conventional "reasoning goal" as overly simplified and narrow in scope.

The importance of developing reasoning skills in young people is not questioned, but the limited range of thinking styles now displayed in the middle/junior high school curriculum is questioned. The panel members believe that this goal as it is now stated in most educational literature needs to be revised and expanded to include a consideration of such attributes as:

1. decision making and concepts of risk
2. nature of proof
3. nonlinear and n[illegible]al forms of reasoning
4. logical reasoning of various types (propositional, dialectical), formal, syllogistic, sentential)
5. coping or adaptive skills
6. values, preferences, and prejudice in thinking

It seems evident that more attention needs to be given to the variety of ways used by people to deal with real-life issues and to attack recurrent science/society problems.

Curriculum

The school curriculum for the early adolescent should be unique to this particular developmental phase. Curriculums that now exist are often extensions of the elementary school program or a simplified version of a high school course. To meet the diversity among students and among schools a wide range of curriculum options is essential.

Panel members see the need for curriculum materials that accommodate the following factors and criteria:

1. Relate to the real world of the student both as an individual and as a member of society.
2. Provide for the great diversity among early adolescents by options in subject matter, learning styles, and levels of cognitive ability.

3. Include correctives for deficiencies in the basic skills (reading, mathematics, communicating).
4. Give particular attention to interdisciplinary connections, bridges, or overlaps among subjects, disciplines and society.
5. Consider the instructional modes likely to realize the goals and intent of the materials.
6. Encourage the integration of minorities into the regular science program.

Panel members expressed a general dissatisfaction with curriculum materials currently in common use in schools for early adolescents. Among the criticisms were these:

1. Lack social and cultural validity.
2. Are insensitive to student characteristics and needs.
3. Do not provide for a wide diversity of learning experiences in various contexts.
4. Are unrelated to the real world, are often trivial, are overly structured and often meaningless.
5. Fail to attract the interest of students.
6. Use a linear organization which may be an obstacle to effective learning.
7. Neglect considerations of values, ethics, or morals underlying the resolution of major science/social problems.
8. Are discipline based, neglecting the social interaction of the subject matter and its relevance to life and living.
9. Do not accommodate the sub-cultures within a classroom, such as race, sex, and background.
10. Fail to respond to the full range of educational goals--career awareness, health management, assuming responsibility, uses of leisure time and others.

Within each of the subject areas (mathematics, science, social studies) of the school there are particular issues and problems relative to the curriculum that need to be explored.

There are schools which have developed worthy curriculum materials for early adolescence and these should be seriously studied for clues and generalizations that may be useful to other schools. There are also a few federally supported curriculum programs designed specifically for early adolescents that should be evaluated for effectiveness.

Informal Education

A variety of out-of-school activities are essential to provide the best possible education for the early adolescent. There is a suspicion among some educators, cultural anthropologists, psychologists, and sociologists that out-of-school learning accounts for more of what early adolescents know than is gained from a formal curriculum. However the issue is viewed, there appears to be a consensus that more attention should be given to broadening and integrating formal and informal learning. Informal agencies (4-H, scouts, "Ys," etc.) and resources (museums, zoos, parks, human beings, etc.) do exist and could be of greater educational service than they are now. Of particular importance, perhaps the greatest, is the study of ways in which commercial and public television can contribute more effectively to desirable educational goals.

It is especially important that the early adolescent has opportunities for:

1. greater access to adult role models than is provided by parents and teachers
2. more experience in community social roles than can be provided in a school setting
3. out-of-school experience and actions, properly planned, to reinforce what young people are expected to know
4. exploring the work places of adults to become aware of career possibilities and the meaning of work

The panel members agree that there is need for more coordination and integration of school and community learning resources. A child cannot learn everything s/he needs to know entirely from schooling, and what is learned out of school should be something more than fortuitous.

Career Education

The nation-wide effort to improve career education in the schools is of particular importance at the early adolescent phase of development. Most 10-15-year-old students have worked for pay and have some idea of what work means. What they need are opportunities both in and out of class to become aware of the career opportunities available to them.

The courses in the curriculum need to be analyzed for careers that are relevant to a particular subject matter. For example, almost every section of a science textbook represents the career efforts of someone who isolated the knowledge included on any particular topic.

Career education is a responsibility of teachers in every subject and should be one of the contextual settings in all curriculum materials.

Instruction and Learning

In developing new curriculum materials for use in the middle/junior high school there is need to relate teaching strategies to educational goals and modes of instruction to the learning styles characteristic of early adolescents. Currently the teaching strategies used with 10-15-year-old students is too inactive for the best results; more field work would be desirable.

Panel members identified a number of learning and teaching issues which need critical study, especially as they relate specifically to the early adolescent.

1. What are the internal and external conditions which influence early adolescent learning?
2. Are there differences in learning abilities and disabilities by subjects, by sex, by cultural origin, and by different environments?
3. What is the level of cognition that teachers may reasonably expect in young people 10-15 years old?
4. What are the ways of knowing? and What is the role of memorization in the knowing process?
5. How effective are the various kinds of support materials used to improve learning, such as games, hand calculators, laboratory experiments, cartoons, etc.?

6. How can instructional programs be adapted to differences in learning styles?
7. Can better methods for diagnosing learning problems and for evaluating student progress be developed?
8. Are there transitional learning skills that early adolescents need to acquire as they move from the less formal elementary school curriculum to the more structured (discipline based) curriculums of the middle/junior high school?
9. The whole question of motivation is in need of serious study.

The panel members recognize that considerable research has been done on some of these issues but there is a lack of synthesis of what is known and a near absence of focus on the early adolescent. We expect that other NSF panels will produce elaborations and identify gaps in our knowledge about learning and we have therefore limited our reactions to a few crucial problems and issues.

Teacher Education

The preparation of teachers for schools attended by early adolescents is more by default than design. Although certification requirements are being developed in about half of the states, the middle/junior high school teacher is typically untrained for dealing with young adolescents. The situation is the same for school administrators.

There are indications that the teacher problem in the middle/junior high schools may be worsening. Some of these indicators are:

1. a general decline in teacher interest in sustaining curriculum and instructional innovations
2. a complacency about exploring a rationale and specifying goals appropriate to the early adolescent
3. inability to motivate the young adolescent and to maintain a suitable level of class discipline
4. an increase in the misassignment of teachers resulting from declines in school enrollments in the lower grades
5. political pressures for budget cuts for the middle/junior high schools

The panel members suggest an extensive program of inservice professional development at the middle/junior high school level. An important focus of this program would be understanding early adolescence. How to work with early adolescents in terms of their unique characteristics is also seen as an important need. Another aspect of the program would be the development, adaptation, or use of appropriate curriculum materials. It will undoubtedly be necessary to improve the knowledge background of teachers in the subjects they teach, but this does not come first in teacher improvement. First is the development of an appreciation and a commitment to early adolescent education. It appears desirable that the curriculum of the middle/junior high schools be more interdisciplinary and this will add another dimension to inservice education.

There <u>are</u> effective teachers of early adolescents and they should be studied for their characteristics and teaching style. There would be a larger number of effective teachers if they had curriculum options, differing in

subject matter and learning styles, and if they were instructed in how to make the best use of them.

The panel recognizes that it is difficult to get teachers to change and this in itself should be an area of study and research. There are many such studies but they are not specific to middle/junior high school teachers, whose needs and areas of resistance are quite special.

Dissemination of Information and Resource Materials

The network of communication among researchers on early adolescence, between researchers and teachers, and within the educational profession itself is weak and uncoordinated. Only recently have several professional journals been initiated with a special interest in topics related to early adolescence. The ERIC system in the various subject fields is not coded to deliver information that is specifically relevant to early adolescence. Typically the codification is elementary school or early childhood and secondary school or adolesence. Hopefully this situation can be changed. The panel members see a need for a well planned communication and dissemination network that is targeted on the early adolescent.

Validation of Issues

The Early Adolescence Panel recommends that the issues relevant to the education of early adolescents be revalidated at five-year intervals. Included in this study should be an assessment of what has been or is being done by school and Federal agencies, professional societies, research associations, and other groups to further the education and well-being of early adolescents. The assessment should include action programs, theoretical insights, research projects, and developmental activities. Demographic surveys on early adolescents should be systematically carried on and at regular intervals. Without these sources of information the proposed validation of issues is likely to be little more than a frivolous activity.

SECTION II. RESEARCH, DEVELOPMENT, AND ACTION PROGRAMS

There is a paucity of research focused on early adolescents and their educational needs. What research has been reported is fragmented and scattered and requires a synthesis to be of much practical use. There is, however, little value to be gained from synthesis studies unless they are done in terms of a relevant theory or model. The Panel on Early Adolescence identified a number of problems which require more knowledge than is now available if they are to be resolved. What is known, however, provides sufficient data for recommending extensive changes in the education of the young adolescent. Panel members are of the opinion that the educational problems of the 10-15-year-old should be explored on a broad frontal basis. They also recognize that in addition to current modes of research, some nontraditional and qualitative methods of investigation may be appropriate in some areas for attacking these problems. It is also recommended that a panel or panels be formed by NSF to further delineate and establish priorities for research and study.

The panel members in recommending the following research and policy studies do so with the recognition that the lists are not exhaustive. The lists do identify areas of concern requiring more basic knowledge if the effectiveness of early adolescent education is to be improved. Some of the items are also treated in the Issues section of this report.

Policy Studies

--There is need to develop a coherent theory or theories of early adolescent development that can serve to focus and interpret the results of research.
--The educational rationale and goals for the teaching of science, mathematics and social studies to early adolescents need to be reformulated and targeted for the early adolescent.
--A conceptual framework is needed to translate the results of research and theory development into curriculum and instructional practices.

Synthesis and Information Gathering

--a synthesis of studies on cognitive styles of early adolescent males, females, and subcultures (ethnic and regional) highlighting differences
--a synthesis of the research in early adolescence to provide a model profile of this phase of development
--a summary of demographic information on early adolescents with plans for the systematic collection of information and at regularly stated periods, for example, family structure, health, housing, recreation, delinquency, socio-economic status, etc.
--a synthesis and evaluation of information and research on alternative schools and programs developed especially for young adolescents

Research and Case Studies

--relationship of "critical thinking" to teacher variables

--natural forms of reasoning used by early adolescents in contrast to formal reasoning
--ability to use various styles of thinking (linear, systemic, formal, logical, decision making, problem solving) and preferred choices
--levels of formal operational thinking in various school subjects such as science, social science, and mathematics
--the impact of social changes on early adolescent development and problems of adjustment
--capacities, proclivities, and agendas of teachers of science, mathematics, and social studies that motivate them to teach innovative curriculums
--external influences, peers for example, which motivate early adolescent interests in learning
--internal conditions, self-esteem for example, influencing learning in early adolescents
--case studies of "effective" teachers of early adolescents
--the role of work in life as it appears to the early adolescent
--preconventional moral reasoning in early adolescence and its effect on classroom behavior and learning styles
--the forms of valid and invalid thinking early adolescents use in negotiating problems of daily life
--the acquisition by adolescents of the social and physical inference strategies they use
--the influence of developmental stages and context upon learning different school subjects
--the effectiveness of concrete and of formal thinking in dealing with interpersonal and science/social problems
--early adolescence as a stage of development as it relates to major social and role changes in our society
--peer influence as a support system for the attainment of educational values
--social perspectives of early adolescents including adolescent alienation
--studies of the classroom culture of early adolescents
--studies of "successful" school programs by trained evaluators to isolate curriculum and instructional principles that may have a wide application
--studies of teacher perspectives and concerns about instructing early adolescents
--studies of what early adolescents learn from informal education sources (This study could begin with a synthesis of what is known about television and learning.)
--studies of effective career awareness programs in schools
--studies of classroom discipline problems and how they may be managed
--teachers as role models for early adolescents

Development and Demonstration

--curriculum modules focused on ethics and values that contrast with anti-rational, counter culture, or expressive values
--the identification of careers related to subject areas of the m/jhs curriculum for teachers and students
--demonstration programs relating science, mathematics, and social studies to work experiences in the community

--seminars for teachers on career concepts as they relate to curriculum and instruction
--new curriculum developments appropriate for all students with options for exceptional students and the science oriented
--curriculum materials which relate to real-life and provide options for teachers; materials based on different rationales and requiring alternative teaching styles
--the establishment of demonstration centers in schools where new programs and practices may be observed
--the development of compensatory curriculum materials specifically for early adolescents

Action Programs

--a wide range of conferences, panels, and symposia on early adolescence
--the establishment of research centers for the systematic study of early adolescence
--the establishment of curriculum resource centers for the distribution of materials useful with early adolescents
--the establishment of a communication network on early adolescence

APPENDIX A

Members of the Panel

Appendix A

Members of the Panel

Dr. Paul DeHart Hurd - Panel Leader
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APPENDIX B

Position Papers by Panelists

May 1978

These eight papers were prepared in response to a request of the Science Education Directorate of the National Science Foundation as part of its consideration of current and possible future activities in science education for early adolescence. Any opinions, findings, conclusions or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the National Science Foundation.

The Young Adolescent: Informal Learning and the Science Curriculum

Robert D. Barr

During the last decade there has been a growing realization that while the transition from adolescence to adulthood has become increasingly complex, secondary schools appear to be less and less effective in providing transitional skills for adolescents in our post-industrial society. Several recent studies on secondary education have emphasized this point and called for major reforms.

These reports include:

1. Maurice Gibbons and colleagues. The New Secondary Education: A Phi Delta Kappa Task Force Report. Blommington, Indiana: Phi Delta Kappa, 1976.
2. B. Frank Brown and colleagues. The Reform of Secondary Education. New York: McGraw-Hill, 1973.
3. James S. Coleman and colleagues. Youth: Transition to Adulthood (Report of the Panel on Youth of the President's Science Advisory Committee). Chicago: The University of Chicago Press, 1974.
4. Edgar Faure and colleagues. Learning To Be: The World of Education Today and Tomorrow. Paris: Unesco, 1972.
5. John Henry Martin and colleagues. Report of the National Panel on High Schools and Adolescent Education.

All of these reports reflected a rather dramatic agreement over the major problems facing contemporary secondary schools. These points of agreement have been summarized in a number of publications.[1]

1. Learning is often discontinuous and fragmented. How it relates to other dimensions of life is often left obscure, or, indeed, proves to have little relevance for real-life situations.
2. Alienation of secondary students from institutional life and from the formational processes of community values manifest itself in the form of hostility, violence, despair, and drug abuse. Furthermore, increased budgets, new physical plants, and cosmetic changes in curriculum have done little to reduce this alienation.
3. High school students are isolated from people of other ages, from participation activities of community life as adults, and from meaningful work experiences.
4. Many aspects of secondary school life are inappropriate as transitional experiences for young adults. In fact, many school experiences tend to prolong adolescence.
5. In most high schools, students make few decisions of any importance and receive no training in the processes of decision making--despite the fact that success in life depends on one's ability to make appropriate choices.

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[1] See Phi Delta Kappa, Walkabout: A Secondary Education Model for Transition to Adulthood, unpublished paper presented to the Phi Delta Kappa Task Force on Compulsory Education and Youth Transition to Adulthood, 1977.

6. Students are maturing physically as much as two and one half years earlier than 100 years ago and achieve their legal majority much earlier as well. Intellectually and psychologically, students also mature much earlier than just a few decades ago. Schools have done little to accommodate these changed rates of maturation.
7. High school students often develop adult attitudes and expectations--and are affected by adult social stimuli--but are not provided with adequate adult contexts in which to express them.
8. Most adolescents lack a sense of worth because the "work" given them is simulated and results in little sense of personal accomplishment or community service.
9. Too many adolescents are information-rich but experience-poor.
10. High school students often lack a sense of identity based on competence, responsibility, and independence. They are taught about these adult characteristics but are seldom given opportunities for developing them.
11. Large consolidated schools have inadequate curriculum or methodological means for recognizing individual needs or personality differences.
12. Activities in school do not relate adequately to the real world away from school, a world in which these young people will shortly be asked to enter as adults.
13. A general curriculum geared to college preparation is unsuitable for a majority of secondary school students. A majority of high school students do not go to college.

In addition to the reports already noted, the National Association of Secondary School Principals has also become increasingly active in this area. In 1972, NASSP published a conference report entitled American Youth in the Mid-Seventies, which focused on action-learning.[2] More recently NASSP held a Wingspread Conference on informal-learning and published a report.[3] The National Commission on Resources for Youth was organized to encourage the development of informal-learning programs and to disseminate information on exemplary programs.

The recommendations for these programs have grown out of a number of common concerns about public education, such as the following:

1. James Coleman has argued that the information-rich environment of the contemporary multimedia society has rendered the "information-giving function of schools obsolete.[4] Many others now urge that the role of schools must be redefined in order to utilize the resources of the community.

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[2] American Youth in the Mid-Seventies, Conference Report of the National Committee on Secondary Education of the National Association of Secondary School Principals, November 30-December 1, 1972 (Reston, Va.: National Association of Secondary School Principals, 1972).

[3] "Action-Learning," Bulletin of the National Association of Secondary Schools Principals 58(November 1974): 1-80.

[4] James S. Coleman, "The Children Have Outgrown The Schools," National Elementary Principal 52(October 1972): 16-21.

2. Far from assisting youth in the process of moving toward maturity and adulthood, schools may be retarding this process. Some observers believe that schools invariably give students little responsibility and few opportunities for making decisions, and that secondary schools continue to deal with youth as irresponsible children. Yet, simultaneously, youth has changed in a dramatic fashion. Society in fact seems to be "dejuvenilizing" our youth.[5]
3. Schools today have a tendency to isolate youth and increasingly separate them from significant contact with older adults, other than parents and teachers. Some concerned critics believe that schools have contributed to the "decoupling" of the generations and acted as "social aging vats."
4. In the past it has been assumed that all formal education should take place in a single institution, the school. Today it is recognized that there are many different kinds of learning. Each may suggest, or even require, a particular setting. Some require classrooms, but not all.
5. The social needs of our communities are becoming increasingly acute; crisis situations grow out of our major dilemmas. Many would argue we can no longer permit the schools to segregate the rich resources of youth and energy from the needs of the day. Neil Postman has put it this way:

   America's towns and cities need all the help they can get, and, in my opinion, most of them can no longer afford to lock up their youth in school buildings for twelve years. It is clear that adults need help in creating livable communities, and the great curriculum question of the seventies is: How can we use the energy, intelligence, and idealism of the young for purposes of social reconstruction.[6]

The dysfunction between school programs and the demands of the social and biological transition of adolescents to adulthood has contributed to a number of unfortunate educational side-effects:

*A recent report by a U.S. Senate Subcommittee reported that public schools in the U.S. are spending more on violence, vandalism and school security than on textbooks.

*Recent documentation of youth alienation and suicide has generated widespread concern.

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[5]For an interesting recommendation for action-learning as a method of assisting youth in their transition to adulthood, see Maurice Gibbons, "The Australian Walkabout: A Model for Transition to Adulthood," Phi Delta Kappan 55(May 1974): 596-602.

[6]Neil Postman, "The Ecology of Learning," English Journal 63(April 1974): 63. For a proposal for a national conscription for all youth to perform action-learning as a public service, see Theodore Sizer, Places for Learning, Places for Joy (Cambridge, Massachusetts: Harvard University Press, 1973), pp. 113-114.

*Schools report all time highs in absenteeism, alcoholism, drug abuse, school disruptions, pregnancy, truancy, and school drop-outs.
*Declining with test scores on SAT.
*Growing concern over lack of motivation among middle school and high school students.

Recommendations for Improving Adolescent Transition to Adulthood

Most all of the studies that have been made of middle schools and secondary schools in the United States have recommended that public education invest far more vigorous efforts in the development of out-of-school learning experiences. The National Panel on High School and Adolescent Education recommends:

> "In sum, despite the numerous types of learning that can and frequently must take place in the community or the 'real world,' the only sanctioned educational experiences of most 12- to 18-year-olds equating of formal schooling with education is not only functionally inaccurate but also often damaging to individual development. Although empirical data on the specific results of various nonacademic experiences are lacking, the problems stemming from the conventional secondary school's inability to be all things to all adolescents are clear enough to warrant designing complementary educational approaches. Thus the Panel recommends that the U.S. adolescent education system actively integrate youth into the broader community by providing a wide variety of out-of-school or 'experience-based' learning opportunities."[7]

The Panel on Youth of the President's Science Advisory Committee likewise advocates placing youths in different roles from the student role, which will involve "learning through action and experience, not by being taught."[8]

One other set of recommendations that relates to out-of-school learning experiences focuses on alternative schools. Most of the major reports on secondary education mentioned earlier have indicated the need for alternative schools and alternative education settings.

School Programs Involving Informal or Out-of-School Learning

Public schools have increasingly moved learning out of the classroom and into the surrounding community. In the past, public schools operated on the assumption that all formal education should take place in schools. Such an assumption is no longer tenable. Authentic learning takes place in various

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[7] The Education of Adolescents. The final report and recommendations of the National Panel on High School and Adolescent Education, (U.S. Government Printing Office, Washington, D.C., 1976) p. 52.

[8] Coleman, Youth Transtion to Adulthood, p. 146.

settings with different sources. Different learning objectives may require very different settings. Some kinds of learning are appropriate for classrooms and schools, but certainly not all. Some learning demands books, dictionaries, libraries, and teachers; other require travel, experience and participation. As alternative schools have sought to match appropriate places and environments with particular kinds of learning, an increase in community learning activities has occurred.

Public school students can be found learning in airports, courtrooms, funeral homes, jails, and hospitals. They are doing volunteer service work in homes for the aged, building houses, buying and selling real estate and conducting archeological digs. Others are learning survival skills through desert hikes, mountain climbing and extended canoe trips. Classrooms have been moved out of the school and located throughout the country. Courses are taught by bankers, carpenters, doctors, editors, lawyers, nurses, plumbers, ...and on and on. Other schools bring the community into the school by using community volunteers, by staffing in-school classes with professionals from outside education and by developing cooperative programs with labor unions, business associations and other private and professional groups. All of these activities have tended to break down the artificial dichotomy between life and learning that has characterized public education in the past.

Action-Learning Programs: The specific types of action-learning experiences vary from school to school, but a definite pattern of types of experiences have emerged. The National Commission on Resources for Youth has concluded that many action-learning programs occurring both in conventional and alterative schools placed youth in distinctly new roles. In a small book published by the Commission, New Roles For Youth In School and Community,[9] these new roles for youth are defined as: Youth as Curriculum Builders, Youth as Teachers, Youth as Community Workers, Youth as Entrepreneur, Youth as Community Problem Solvers, Youth as Communicators, and Youth as Resources for Youth.

Learning in the Great Outdoors: The utilization of a natural setting as a learning environment has grown rapidly in recent years. School districts across the country are beginning to utilize the geographical assets of their areas through hiking, back-packing, bicycling, canoeing, spelunking, and camping experiences. Many of the programs are being developed for students who have not succeeded in academic learning and traditional classrooms. The programs have also attempted to use the cultural neutrality of the outdoor environment as an ideal place for confronting and reducing racial antagonisms.

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[9] National Commission on Resources for Youth, New Roles for Youth in the School and the Community (New York, Citation, 1974).

A wilderness program was developed at Northwestern Junior High School in Battle Creek, Michigan, in 1972-73 to alleviate racial and class conflicts among students. The program was not only endorsed enthusiastically by students, teachers, and parents, the school also experienced a 75 percent decrease in discipline referrals of a racial nature.

The Brown School in Louisville, Kentucky, is a public school alternative with an equal racial mix of black and white students on the basis of voluntary enrollment. Finding that school classrooms were not the best place to try to deal with racial antagonism, the school staff developed a weekend outdoor camping program, especially designed to confront black and white students with entirely new situations. Students and staff found the experience to be extremely productive in the area of racial understanding, so the students developed their own proposal for a school camp and are approaching foundations in a search for funds.

The Cambridge Pilot School in Massachusetts taught inner-city youth who were lacking in academic skills the techniques of outdoor education, and then used these students as guides and teachers for more academically able students. The self-concepts of the target students improved.

In Grand Rapids, Michigan, a week-long camp-out on Isle Royal culminates a series of weekend camping experiences. The camp-out serves as an external reward which encourages students to work on basic educational skills in the school's behavior modification program. Thus, the camping program is designed to motivate academic learning.

Probably the best known outdoor education program is Outward Bound, with headquarters in Denver, Colorado. Outward Bound has assisted schools throughout the country to develop programs that involve both students and teachers in outdoor situations where they are faced with seemingly impossible tasks that call upon the maximum in personal reserves and individual perseverance.

Learning in Unfamiliar Cultures: A number of schools have developed action-learning programs that immerse school age youth in cultures different from their own. Students at East High School in Denver have harvested beets with migrant workers, worked in welfare agencies, served food in soup lines, spent weekends on a Navajo reservation, lived with Mexican families, and collected garbage with city sanitation workers. All such activities are recognized with high school social studies credit. In Lincoln-Sudsbury Regional High School near Boston, students lived for five weeks with black inner-city families while working in social agencies. The inner-city experience was followed by five weeks in remote rural settings in Connecticut and Nova Scotia where they worked on farms, in dairies, at maple syrup factories, and at organic food cooperatives.

Learning in Service Agencies: One of the most practical and potentially valuable action-learning experiences involves the use of secondary school students as volunteers in various community agencies and programs. Students volunteer their time and energy to work in hospitals, homes for the aged, drug centers, mental health clinics, and other social agencies. Some students have even organized their own agencies and offer services within their communities. In Adams City High School in Colorado, students leave

school to work as tutors and teachers for second and third graders, thus providing elementary teachers with needed assistance. The Yorkville Youth Council in New York City is another program that uses adolescents as teachers and tutors. Student volunteers in Marion, Indiana, have become an important part of the staff at the local Veteran's Administration hospital.

A number of drug programs throughout the country use high school students as counselors; some of these programs have been planned, developed and operated completely by high school age students. The National Commission on Resources for Youth, Inc. has identified four exemplary crisis drug centers utilizing student volunteers.[10] Project Community in Berkeley, California, attempting to fill the need left by "a faltering church and seriously ailing school," has programs of human growth and understanding, a cross-age-group learning programs. "Number Nine" in New Haven, Connecticut, is a crisis center that was designed, initiated, and implemented by youth. "Encounter" in New York City is a non-residential drug center designed to help people to cope and survive, despite easy availability of drugs on neighborhood corners. Another program in New York is "Compass," a residential drug program. All of these programs, and many more like them, represent efforts of today's youth to deal with their problems by helping one another.

Perhaps one of the most dramatic examples of the potentiality of youth volunteers was provided by the Community Medical Corps, organized in the Bronx of New York City. In the early 1970s, a group of medical students recruited 110 high school students from 14 to 17 years of age to assist in screening children in local tenements for traces of lead poisoning. The students were put through a rigorous orientation session, given white medical jackets, and put to work canvassing neighborhoods and conducting blood tests. By the end of a summer program, the students had seen over 3,000 children and taken over 2,000 blood samples. Over 2 percent of the children tested were found to have dangerously high levels of lead poisoning. The following was written about the program:

High school age youngsters had proven that they could be depended upon to do difficult work. Many of them had come into the program originally with an awe of doctors and what they did. By the end of the summer, the directors reported, "We had kids telling the doctors what to do. They had assisted with blood taking hundreds of times and knew the job as well or better than any doctor." The kids who worked here, all of the 110 kids, know more about lead poisoning than most doctors.[11]

As a result of the program, many students are now determined to become nurses, teachers, social workers, and doctors. The program exemplifies the fact that adolescents thrive on significant, meaningful work.

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[10] Mildred McClosky with Peter Kleinbard, Youth Into Adults: Nine Selected Youth Programs (New York: National Commission on Resources for Youth, Inc., 1974).

[11] Ibid, p. 91.

Learning in the Professional Community: Internship programs have proven to be one of the most popular action-learning experiences. While many internship programs have a career or vocational emphasis, a large number of such programs emphasize social and academic areas. Students are moving into the professional community, working with leaders in private business, government, social agencies, cultural centers, and serving just about anywhere that professional men and women are at work. A student from Herricks High School in New York City worked for one day each week at a research center studying with a doctor researching formations in the blood. In Webster Groves, Missouri, high school students work half-days in offices throughout the city and change positions three or four times each school year. In Grand Rapids, Michigan, students work in local courtrooms and government offices and even in mortuaries. Often these internship experiences are the core learning experience for youth. They usually take place during eleventh or twelfth grade, and usually run for an entire semester. The Brown School in Louisville has developed a program where students can complete all their academic requirements by the end of the eleventh grade. This enables interested seniors to spend a year full-time in one or more intership positions.

While an increasing number of schools of all kinds are establishing social internships in their local communities, there are two national programs that have been organized to assist local schools in developing effective internship programs. Located in New York, the Executive High School Internship Program has developed a network of school districts in six states which participate in student internship programs. The program enables juniors and seniors to take one-semester sabbaticals from their regular studies to serve as special assistants to federal commissioners, judges, museum curators, and senior executives. The students spend four days per week in the internship, and plan and conduct weekly seminars. None of the participants is paid, but all receive credit. A similar organization that offers schools assistance in establishing internships is Dynamy, Inc., located in Worcester, Massachusetts.

Learning from the Past: A number of schools have involved secondary students in action-learning projects that focus on preserving local history and folklore, reconstructing past cultures, or recording oral history. Students in the Atlanta Public Schools' Independent Study Program spend three months away from school and gain full credit for work at an archeological dig preserving remnants of an ancient Indian culture. In Brooklyn, New York, students attempted to refute historians' contentions that residents of Weeksville, a black community in nineteenth century New York, were "drunken, shiftless, and lived in shacks." Students worked in the midst of the demolition that preceded a Model City construction. They searched through foundations, in cisterns, wells and attics, behind mantelpieces, and between walls, looking for evidence of the Weeksville community. Material the students discovered indicated that many members of the black community lived in permanent and comfortable homes, dressed well, read extensively, and attended school. Some of the new information that the students found has been used by Encyclopaedia Britannica.

In Grand Rapids, Michigan, a group of high school students investigated, wrote, and did the layout on a book about their city which was published and adopted by the public schools as a textbook.

In Rabum Gap, Georgia, an English teacher encouraged students to go on collecting tours through Appalachia, gathering knowledge about the folklore and culture of the area. The students recorded how to build log cabins, how to weave baskets, how to make traps and so on. The student activities have attracted such high interest that their findings are now recorded in a number of major publications under the title of Foxfire.[12] Similar enterprises have also been developed by Alaskan students, Sioux Indians, Flathead Indians, Navajo Indians, and high school students in several states all of whom started their own publications focusing on local folklore and culture.

Learning In Construction and Urban Renewal Projects: Students have also entered into action-learning projects designed not only to be financially rewarding, but also to be focused on beautifying and renewing their communities. In Denver, Colorado, a group called "Creative Urban Living" has negotiated contracts totalling more than a quarter of a million dollars to build and refurbish houses, replace several blocks of city sidewalks, and construct several mini-parks for the city. The students keep records on banking, payrolls, bills, loans, and insurance, and even publish a newsletter. In Canton, Ohio, high school students have worked for twelve years in a Candlelight Youth Corps, renovating houses of the handicapped, the elderly, and the blind. Students also built a house and two duplexes and sold all three. Similar construction projects have been formed in Mollala, Oregon, in LaPuente, California, in Indianapolis, Indiana, and in many other school districts throughout the country.

In Minnesota, a group called Teen Corps organized 350 teenagers to provide volunteer labor to worthy projects around the state. The students built five summer camps for mentally retarded youth, a home for juvenile delinquents, a social center at a migrant worker camp, and an inner-city park. In Sacramento, California, volunteers visit welfare recipients' homes, screen cases, and assist in refurnishing and repairing houses.

Learning on the Road: A few schools have organized traveling learning experiences that combine academic study with on-site visitation and experience. St. Paul Open School students have traveled to the Dakota Badlands and to the Gettysburg Battlefield to combine geological and biological study with study of culture and history. In Lake Geneva, Wisconsin, a group called the American Essence Traveling School offers a program for high school seniors and postgraduates in which young people spend nine months crossing the United States by rail, highway, footpath, inland waterways, and even wagon trails. The program is designed as an in-depth immersion in America's heritage in the hope that the participants will gain a deeper commitment to the future based on a personal awareness of the past. Many schools, of course, have much less ambitious programs of weekend travel and summer experiences.

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[12] Eliot Wigginton, The Foxfire Book (New York: Doubleday, Inc. 1973)

Learning in the Political Arena: Encouraged by the student activism of the late 1960s and early 1970s and armed with the right to vote at age eighteen, some high school students have moved forcefully into the political area. Students of East High School in Denver went to Greenwood, Mississippi, to assist in voter registration. The Connecticut Citizens Action Group, the first affiliate of Ralph Nader's Center for the Study of Responsive Law, provided a model for youth participation in communities all across the United States. The students in Connecticut have conducted a statewide survey of food prices, developed an Earth Platform for election campaigns, and lobbied state legislators for a disposable bottle tax. And all this has been done after school and on weekends, without school credit. In other states, students are participating in a pool of volunteer workers to gather information, conduct surveys, and then utilize their information to influence voters, candidates, and legislators.

Another program that involves students in action-learning in the political arena is the Washington, D.C., Street Law Program. Offered as a high school course, the program is built around sixteen law students from Georgetown University who teach the "street law" courses. The courses use discussion groups and special projects, and culminate with students conducting a simulated trial with a federal judge chairing the proceedings. Both the high school students and the law students earn credit for this work. The program has become a model for such courses in other school districts.

Students in the St. Paul Open School have a consumer action program designed to investigate consumers' problems and initiate correctional action.

Learning in the World of Work: Career and vocational education offer almost unlimited opportunities for action-learning; an added incentive for secondary eductors is that such programs are supported by federal funds. The Office of Education has developed an Experimental Based Career Education that is much more than a terminal program for noncollege bound students and that is a far cry from on-the-job training. Experimental Based Career Education defines careers broadly to mean "one's progress through life" or "life paths"- not a restricted nine-to-five segment of life. The program enables students to complete the last two years of high school by participating in extensive experiences, independent and group study, and many activities. Graduation requirements are based on survival competencies rather than course completion, a significant development.

One of the Office of Education programs is located in Tigard, Oregon. The program enables students to leave school during the last two years for action-learning. During this time students attend no classes. They demonstrate their competencies in things it is assumed most Americans should know in order to function effectively in their daily lives. Each competency is judged by a specific community adult. Another impressive career education program is found at Skyline Center in Dallas, Texas. In a school staffed by professional teachers and craftsmen, and utilizing skilled professionals throughout the community, students may survey as many as twelve career opportunities during one year.

An important action-learning program that has been in operation for a number of years is the National Junior Achievement Program. In this program, students use consultants from the business community to assist them in

organizing a business, producing and marketing a product, and generally participating in the entire range of experiences associated with running a business.

Action-Learning: Some Reservations

While there is currently an increase in interest in action-learning, some cautions should be mentioned. The following are major concerns to be taken into account:

1. Action-learning poses extremely difficult scheduling problems because the programs of public secondary schools were not designed to provide community-based learning. Consequently, action-learning often has been scheduled as supplementary to regular classroom work, or as a component for one particular course, or as independent study. Some schools provide semester-or-year-long "sabbatical leaves." Some proposals for action-learning have moved in the direction of "high schooling without high schools" by advocating alternatives to school rather than alternative schools. Few schools have been able to operationalize Edward Meade's suggestion that the schools act as a "broker for sending youngsters to and from the 'real world of experience.'"[13]
2. The matter of legitimacy must still be raised. Many question whether or not these programs really belong in schools even though the research available on action-learning is generally favorable.[14]
3. Many of the action-learning programs described earlier are very expensive. This poses a difficult problem. One response is that of the National Commission on Resources for Youth, which recommends that all action-learning should be financed through student projects to earn funds.
4. The most difficult problem of all may be the question of availability of opportunity. All of the programs that have been described are small; some are only pilot projects. What happens if all students--or even a major proportion of students--are to be involved? The organizational and administrative problems are mindboggling. The added problem of finding available opportunities outside the school is also formidable.
5. The question of accountability is a difficult one. A number of state departments of education have begun to develop guidelines and accept credits for action-learning. Sometimes credit is tied to existing courses, tied to hours of participation, or dealt with in an ad hoc manner. Yet much work is still to be done in the area of organization and administration if action-learning programs are to be carefully monitored and evaluated.

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[13] Weinstock, The Greening of the High School, p. 33. (A good example of a school acting as a broker is the Action Learning Center, Niles Township High School, Skokie, Illinois.)

[14] Alexander M. Moore, "Evaluation and Action-Learning Programs," Bulletin of the National Association of Secondary School Principals 58(November 1974): 65-74.

Information Learning

Perhaps the most potentially potent area of learning opportunities resides outside the usual interest of planned school programs. This area is the informal learning that occurs as young adolescents view television and movies, use local libraries, participate in a wide variety of youth organizations i.e., FFA, Scouting, etc. Such television specials as Roots, The Holocaust, and King, provide for powerful learning opportunities. National Geographic television specials, Jacques Cousteau television specials, the Nova Series, and a variety of other educational programs likewise represent the finest in enjoyable learning.

Increasingly, television networks are developing teaching materials to encourage teachers to utilize their products for classroom instruction. Youth today have calculators, electronic games, cassette audio and video recorders, cameras . . . They are children of technology and have steped into a new world filled with fun learning. To date, no one has seriously investigated the impact on all of this or the scientific learning of school youth. And while schools are increasingly using these devices, programs, and activities in schools, much more needs to be done in exploring effective ways of utilizing them in the total learning program of young adults. Work also is needed in assisting teachers in the utilization of these new aids to learning.

Conclusions and Recommendations

All of the above school programs are or could be developed at the middle school level, and all have dual implications for the area of science education. They offer unique opportunities for interdisciplinary components of science, social studies, and math education. They also offer the unique opportunity to relate theory to practice; to relate classroom instruction to the realities of the larger community. They offer the young adolescent the opportunity to come in direct contact with a variety of age groups, role models, and life situations. The Alternative School Programs and Action-Learning Programs demand personal choice and decision making and provide the opportunity for young adolescents to gain experience and reinforcement in areas not usually dealt with in the school curriculum.

Recommendations:

1. A more careful study of out-of-school learning experiences that relate to science education should be conducted to:
   - determine effective programs
   - determine the impact of them on the young adults
   - identify effective instructional models in this area
   - identify necessary teacher skills and emerging instructional roles
   - identify problems and liabilities of out-of-school learning programs
2. A new type of curriculum development is necessary to provide teachers with useful instructional programs involving out-of-school and informal learning experiences. This would include the development of models, procedures, and strategies, as well as printed instructional

materials. Programs like the one developed at the Indiana University Social Studies Development Center for the study of the school political system offers a useful model.

3. A major program of teacher education should be developed to help teachers learn about out-of-school and informal learning experiences, and the skills and strategies necessary to utilize these experiences effectively.
4. A major funding area could be the area of informal learning. Increased attention should be directed toward studying this very powerful area in order to determine ways of providing more effective learning experiences for the young adolescent.

Perspective and Recommendations for the Science Education Directorate

Diana Baumrind

PERSPECTIVE

1. A National Youth Policy: Critique

A. Presuppositions

The recent proliferation of commission reports, critiques of these reports, and books on the subject of children's rights seems to indicate a growing public concern with the problems faced by contemporary youth as well as with the problems they generate. The commission reports include the Panel on Youth of the President's Advisory Committee, known as Coleman II (Youth: Transition to Adulthood, 1974), The Reform of Secondary Education established by the Kettering Foundation, B. Frank Brown, Chairman (1973), and the National Panel on High Schools and Adolescent Education chaired by John Martin (The Education of Adolescents, 1974). Critiques include an entire issue of the School Review devoted to the Coleman II report, a series of reports put out by the Social Research Group of George Washington University (Adolescence Research Opinion and National Youth Policy: What We Know and What We Don't Know, 1976; Continuing Issues in Adolescence: A Summary of Current Transition to Adulthood Debates, 1976), and a scholarly commentary prepared by the Rand Foundation for DHEW called Youth Policy in Transition (Timpane, Abramowitz, Bobrow, & Pascal, 1976). The books on children's rights include The Rights of Children prepared by the Harvard Educational Review (1974), Birthrights by Richard Farson (1974), and Escape from Childhood by John Holt (1974).

The recent rash of commission reports call for basic and sweeping revisions in our educational and juvenile justice systems but fail to provide theoretical or empirical justification for believing that these revisions would resolve rather than sustain the problems they address. The institution most favored for social experimentation in the last decade has been the public school and the results, in my opinion, have been counterproductive. For example, the extremely well-financed, widespread experimental alternatives to traditional education in Berkeley were accompanied by poorer academic performance as measured by standardized tests, particularly among minority students, and by aggravated disciplinary problems. The permissive standards applied to black children defied the stated preferences of black parents, educators and leaders who demand structured settings and firm classroom discipline. Berkeley Black Parents for Education presaged Jesse Jackson's central motif in PUSH by demanding that black students be placed only in structured classrooms and that district staff stop making concessions to their children for being black by demanding less of them in the way of performance or good behavior.

Our nation's most radical educational innovation, namely integration of the classroom by ability and subcultural background, has yet to achieve either of its two stated objectives: to promote scholastic achievement among blacks and to reduce interracial prejudice. And what psychological principles can be invoked to suggest that it should accomplish either objective? The cognitively disadvantaged child competing with white middle-class children in

competence contexts whose standards he fails to meet predictably reacts with frustration, rejection of the learning context, and aggressive classroom behavior. Black and white children are thrown together for the express purpose of remedying the inferiorities of the former under conditions in which these inferiorities are highly visible and irremediable, in contexts where racially instigated violence cannot be deterred or contained. Predictably, interracial prejudice remains rampant in our high schools (Glock, Wuthnow, Paliavin, & Spencer, 1975).

A major criticism of the commission reports just cited is that they describe the situation of the white middle-class youth and use it as the standard for all. The consequences of initiating the reforms suggested are not examined for subcultures defined by race, class, sex, or family structure. Different teaching strategies, although not necessarily different substantive goals, may be required to teach science, and scientific methods to diverse subgroups. The composition of sections, if not classes, may require homogeneity rather than "integration."

Commission studies such as those cited are intended to bring to policymakers the informed consensus of the intellectual community. But in fact there is no consensus informed by social science findings. Rather report recommendations flow from a politically expedient tacit ideology whose presuppositions are seldom stated or disputed. For example, radical innovative efforts have simply presumed that comprehensive high schools cannot succeed but smaller, decentralized ones can; that youths want and will accept more age integration; that increased participatory democracy and decreased adult authority will reduce alienation; that the more options young persons have the better the outcome; and that early physical maturity is accompanied by commensurate social and emotional acceleration. These are all presuppositions that should be made explicit and subjected to theoretical analysis and empirical research prior to being incorporated into our national youth policy.

Utopian solutions that do not contend with social realities cannot but fail. It is the mark of the liberal reformer to deny two aspects of reality--scarcity, the social reality of which necessitates unequal reward for unequal merit; and the personal reality of evil, which requires effective deterrent measures rather than a fatuous amiability towards every form of human misconduct, especially when committed by juveniles.

B. Recent Social Policies

Although most young people negotiate the transition to adulthood without capturing the attention of social authorities, the greatly accelerated rates of adolescent criminal behavior, serious mental illness and suicide clearly justify the attention and public support the field of adolescent research and national youth policy is presently receiving. However, many critics, including myself, dispute the thrust of certain social policy changes and commission recommendations on several grounds.

1. First, the current emphasis on children's entitlements and rights has precluded adequate attention being paid to children's welfare and obligations. The social movement in the U.S. that has as its worthy objective to grant more power to powerless adults has expanded without reason to include dependent children, thereby presuming against all evidence that children are the victims rather than the beneficiaries of adult sovereignty When social scientists

(e.g., in Coleman II, p. 118) refer to youth as a "subordinate nation" and argue that youth constitutes an under privileged, exploited class of citizens, they promote an attitude of victimization. Social policies and programs affecting youths should instead promote a sense of personal agency and internal locus of control and a work ethic.

2. Second, adolescent research funding has shortchanged the needs of both the average young person and the exceptionally competent, constructive youth. Full self-realization requires internal locus of causality, a sense of personal agency, self-reflective action, and an autonomous sense of social responsibility. A scientific attitude also requires these personal characteristics. Outstanding ability and achievement deserve recognition and encouragement. Indifference to individual achievement and merit denies the very uniqueness that gives worth to the individual. The context of uniqueness is given by acquired excellences, virtues and achievements, each of which is unequally distributed in any society and all of which mature with age. Science program goals must match the abilities and achievement motives of their recipients.

3. Funds for adolescent research and development programs have been channelled reactively into crisis management, emphasizing destructively deviant youthful behavior, while support for research focused on basic developmental processes has dwindled. The channelling of money into science education for young adolescents is a step in the right direction. There is every reason to think that early adolescence is a proper stage of development to which to direct a program introducing scientific concepts and methods.

4. Dramatic historical fluctuations are receiving more attention than long-range secular trends from which they are not properly differentiated (Timpane, et al., 1976). Crises associated with historical fluctuations are likely to return to more typical patterns without major policy intervention, while problem behaviors associated with secular trends require long-range, persistent efforts at a federal level. Dramatic historical fluctuations that were mistaken by many (most notably Charles Reich, Greening of America, 1970) for secular trends include the extreme anti-authority attitudes among youth in the 1960's which were a direct result of reaction to the Vietnam war and draft and which subsided with the end of that fiasco. Two examples of secular trends not sufficiently addressed by the forementioned commission reports are: (a) changing sex roles, and (b) the psychological effects of scarcity in a shrinking economy. Rejection of sex role stereotyping results in changing roles for men and women. Compensatory attempts to counter the reluctance of adolescent girls to tackle mathematics and science facilitates such role change. Since scarcity of goods and services must now be regarded as a permanent condition, exploration of the meaning and consequences of scarcity would make an excellent kernel around which to build a social science program. The restrictions of finitude relative to want should be faced and their consequences examined by youngsters. One such consequence of the economic reality of scarcity is the requirement of unequal rewards for unequal achievement, (from each in accord with his ability; to each in accord with his deeds); no one of whatever age where scarcity is a reality can be rewarded for doing his own thing unless that thing is valued by others.

II. On the Mission of the Science Education Directorate: Recommendations

A. Metastrategic

In order to use consultants such as myself most effectively it would be desirable to clarify the following: (1) The relation of the Science Education Directorate to other federal and NSF agencies concerned with education and social and behavioral problems and the extent of power delegated to the various agencies to determine educational policy and/or conduct research; (2) The specific function of the research planning effort of which the Early Adolescence Panel is a part, and how it coordinates with the functions of the other nine panels meeting simultaneously. What exactly are the decisions to be made? (3) The specific role expected of each particular participant. For example, I am a specialist in socialization antecedents of social competence in children of different ages. I am not qualified to make "dollar specific recommendations" concerning Science Education programming and will not attempt to do so.

In writing this paper describing my perspective and recommendations for the Science Education Directorate I would have liked to address a set of carefully formulated questions designed to fit my area of specialization thus assuring myself that my comments were on target and that the discussion at the meetings would have an explicit focus.

B. Epistemological

I would like to propose a perspective on social reality to apply to program development in science: If theories are to impact realistically upon practice, they must relate to concrete phenomena in their real contexts and interconnections. Abstract ideas and ideals concerned with purely hypothetical circumstances (e.g., Kohlberg's stages of moral reasoning) do not further that endeavor. To presuppose that any thing has a fixed nature, properties and course of development apart from context and circumstances is to think metaphysically. The mental measurement concept that there is a fixed quantity of intelligence is an example of such a metaphysical abstraction (which is not to say that what an intelligence test measures is not highly predictive of concurrent performance in a standard academic setting). The relations among physical and social objects are characterized both by binary opposition (either/or) and dialectical opposition (both/and). A "thing," be it an object or an ideal, is a range of possibilities with discrete potentialities becoming manifest in particular contexts. Polarities such as assimilation and accommodation, freedom and necessity, discipline and autonomy, achieve meaning only in their mutual dependence. Equilibrium is temporary while the unity of such opposites is permanent, reflected in consciousness as psychological conflict. That a given thesis is found to be insufficient is not a reason to assert that its antithesis is thereby correct. If a thesis such as "children should be taught subject matter" is found insufficient, one of its antitheses, that "children should be taught how to learn" is not thereby correct. An hypothesis synthesizing thesis and antithesis, for example, that "children should be taught subject matter using a strategy consistent with their stage of development and preferred cognitive style" is an hypothesis more probably true.

Further, humans are not mere products of circumstances and upbringing but instead develop as a result of their own activity in contending with their circumstances. It is not sufficient to place people in improved environments in order to transform them, nor is it sufficient merely to elevate their ideas. Development for an individual is a result of his or her acting upon circumstances; ideas are derived from that active process. Particularly in early adolescence it is more important for youngsters to engage in scientific thinking and activity than to learn a given body of scientific data.

Maturation and training are two sides of a single process; the child develops by being trained. A valid understanding of individual differences is predicated on an understanding of the developmental regularities which interact with these differences. As the cognitive developmentalists claim, development, unlike growth, is qualitative and discontinuous; successive transformations improve the adaptive functioning of the individual; advanced stages are more differentiated and hierarchically integrated than previous ones; and within a given cultural and historical context there are predictable regularities in a child's development of knowledge. However, there is good reason to dispute other common presuppositions of social cognitive-developmental theorists such as that there are culturally universal stage notions that can be applied to cultures as well as to individuals. And it remains to be demonstrated that formal operational thought is a necessary or sufficient condition for becoming a good person or a successful achiever, or that adolescents actually have access to formal operations when stressed or implicated.

American science, particularly in education, has a counterproductive tendency to pose problems and solutions dichotomously, and in metaphysical terms. In response to the demands of policy makers, a group of scientists agree to "solve" a problem plaguing the country such as ethnic discrepancies in academic achievement. Solutions are presented which fail to take into account certain intransigent realities (e.g., subcultural differences in pattern of cognitive abilities) and therefore necessarily fail to live up to expectations. The reaction to their apparent failure is to reject the solution as totally false and propose the opposite as true. Thus fashions in education are characterized by periodic swings between "traditional" solutions and "radical innovations," each totally rejecting the tenets and criteria of success of the other; one-sided solutions are rejected in favor of their equally one-sided polar opposites.

Important as I think adolescence is as an opportunity for accelerated learning, I most definitely do not accept the notion popularized in the press, although not in scientific journals, that experiences in infancy and early childhood have little impact on later development. The failure of most compensatory education programs to live up to their claims does not justify the positive assertion that intervention in the early years is not a precondition of full utilization of academic potential in adulthood. Nihilistic statements based on the assertion of the null hypothesis may have journalistic value, but totally lack scientific merit. The fact is that there exist many extremely successful (and underfinanced) preschool intervention efforts such as the black-run Nairobi preschool center in East Palo Alto that can and do teach socially disadvantaged black preschoolers to read and attend; there is reason to believe that these gains can be maintained in a primary school run according to the same principles. These successful efforts have not been studied sufficiently if only because those who do, don't write. There is much

less evidence that academically backward adolescents can recoup their early losses and no theoretical grounding for programs which have that as their objective. The notion of the "elastic mind" is just that and nothing more. It cannot justify the application of learning methods in adolescence that failed to produce results in early childhood. The fact that evaluation studies fail to show success (e.g., of early intervention by academically oriented programs) can not be taken as evidence that their opposite (e.g., late [adolescent] intervention by socially oriented programs) will succeed. Instead the characteristics of those programs which have succeeded for a particular subgroup (e.g., Nairobi preschool program) should be examined and principles induced by trained evaluators who can then recommend community support for successful experiments. Specifically, teaching contexts that combine strict discipline, drill and high expectations with a loving inspirational approach seem most successful with black (perhaps all) youngsters. Necessary preconditions for success include supportive services for families and insistence on self-help and responsibility by families served. These are the characteristics recommended by Jesse Jackson in his Operation Push and by most black parent-groups, and characterize what appear to be successful programs such as Nairobi. The same methods, however, may or may not be effective with older children brought up in middle class homes with elaborated linguistic codes.

III. Science Education Programs

A. Approach

Emphasis in early adolescence of science education programs should be on the process of scientific thinking, and logical deduction and induction. Dialectical (Hegelian, Marxist) logic should be taught in addition to standard (Aristotelian) logic as a way of encouraging non-rigid thought not dependent upon binary opposition. Prejudice may be associated with encapsulation in dichotomous categorizations such as good/bad, insider/outsider, and self/other. Unfortunately, the majority of teachers lack training in scientific and logical thinking. Courses at the college and graduate level should first be initiated and then methods of teaching scientific method to adolescents explored. Scientific method should be taught within the context of a general science course such as biology or human behavior.

In junior high school the range of cognitive styles, levels, and interests is probably much too broad to accommodate to integrated classrooms. Lectures could be given in integrated classrooms, but the sections in which the process of thinking scientifically is explored will probably have to be separated according to cognitive style and stage. Despite its political unpopularity, segregated sections may be required; ideological presuppositions should not be allowed to interfere with accomplishment of important educational objectives.

B. Research Programs

1. Studies of reasoning in situ by early adolescents: the role of formal operational thought. The forms of valid and invalid reasoning youngsters bring to bear as they go about negotiating daily life should be studied

in situ. Structured discussion can be used to produce videotape records to analyze the cognitive processes used by adolescents to convince each other in practical discourse concerning controversial issues. Natural reasoning as contrasted with formal reasoning (see Braine, 1978) should be studied in students and their teachers; there may be alternative routes for teaching logical thought. How do early adolescents with and without formal operational thought reason naturally, what errors do they make, and by what alternative routes (if any) can they be taught the scientific methods?

The acquisition by adolescents of social and physical inference strategies deserve focused study; this would have practical value as well as provide data to test information theories. Reasoning in situ requires many cognitive abilities in addition to formal reasoning (e.g., roletaking ability to see the perspective of another, attention to concrete detail and context in order to identify the appropriate rule to be applied, and ability to break set to avoid intuitional traps. What is the relation of stage of physical (or moral) reasoning to the tendency, in situ, to fall into the logical "errors" described by Tversky and Kahneman (1971a, 1971b) and Ross (1977)? It would appear that the acquisition of formal operations does not secure the individual against such "errors" in prediction as correlation error (over-estimating cross situational consistency); or regression error (disregarding baseline rates in favor of dramatic exceptions). (I suspect that these so-called "errors" have survival value and therefore are not in fact errors.) The acquisition of cognitive strategies for efficient accurate problem-solving may occur via alternative routes in different individuals; the adolescent thinker may learn best when permitted to use his preferred cognitive style.

A good deal is already known about the general characteristics of the adolescent as a thinker. Some adolescents, perhaps most, are still concrete thinkers and limited in their reasoning about events to immediate or past experiences; they have difficulty in coping with problems involving more than two dimensions or relations simultaneously. The adolescent, who has negotiated the transition between concrete and formal operational thought is enabled to distinguish between the real and the possible, to hypothecate contrary-to-fact possibilities. The extent to which adolescents' capacity for constructing systems of thoughts or theories which permit hypothesis formulation and testing through independent manipulations of variables is actually utilized in academic and social problem solving contexts remains to be determined. More empirical research concerned with formal operations is required to determine whether formal operations is in fact a characteristic potentially of <u>all</u> normal adolescents, even in Western society.

(a) Under what, if any, circumstances do individuals who display formal operational thought on Piagetian tasks actually employ that stage of reasoning in situ?

(b) How functional is concrete thought in solving hypothetical social dilemmas by comparison with formal thought? Is it possible to develop routes other than formal reasoning (e.g., interpersonal reasoning using role-playing skills) that are equally successful in solving social problems requiring reasoning about real-life interpersonal encounters or social scientific problems? While propositional logic may be essential in solving scientific problems in physics and chemistry, it may be insufficient even there. Social reality is not characterized by either/or properties or linear relations; therefore formal logic may not suffice to negotiate social reality.

2. The characteristics of early adolescence as a stage require study. Early adolescence is a period of major stress, biologically, cognitively, and psychosocially. Major biological changes radically alter body chemistry and appearance. The early adolescent must adapt to a new stage of social reality, leaving the relative security of grade school for the demanding and heterogeneous environment of junior high school. Major role changes take place as dependency upon parents is relinquished and peers become more salient. A new set of normative reference groups, values, and behaviors develop. Innovative educational programs require adaptation to the range of characteristics of the target group.

(a) Early adolescence is a period of extreme self-consciousness and change in body image (e.g., Simmons, Rosenberg & Rosenberg, 1973). Our ongoing research suggests that girls are particularly vulnerable and insecure as a result of their exquisite self-consciousness. An anxious child afraid to talk in class or be made fun of obviously will have trouble learning in the average classroom. How can threat to self-esteem resulting from increased body consciousness be reduced (e.g., by sitting around a table and not having to rise to speak)?

(b) Identity formation (Erikson, 1959) is the outcome of adolescent experimentation with different lifestyles, resolution of bisexual conflicts and emancipation from childhood dependency eventuating in crucial decisions concerning school, love, and work. How changing values concerning sexual behavior and gender role affect adolescent identity formation, and indeed what constitutes identity formation in various subgroups, deserves study.

(c) Adolescence is a life-stage characterized by tension and suffering but without adequate inner resources to cope with pain. The negative forms that attempts at coping may take, including substance use, acting out, and withdrawal, deserve continued study, as do alternative adaptive forms of coping such as physical fitness regimens and meditation.

(d) The effect of the advent of formal operations on the adolescent's attitude towards school and family authorities requires further study. The formal adolescent thinker is in limbo between the safe, concrete reality of childhood and the indeterminate reality of adult commitment. Liberated from the literal reality to which he was confined as a child but not yet constrained by adult commitment to work and family, the adolescent can be omnipotent in imagination but remain relatively impotent in action. Newly awakened to the imperfection and hypocrisy of the adult world but with freedom born of nonengagement and noncommitment, the middle class adolescent may reject and criticize this world in a way adults may find irritatingly naive or refreshing and idealistic. It would appear that adolescents need opportunity both to be a part of a social system where their actions have real effects on others whose reactions then have real effects on them, and to function in safe spaces where actions and decisions do not yet have the serious and permanent consequences they would at later stages of development. Engagement in serious science projects for some youth might provide one such opportunity.

(e) More studies of social perspective-taking in junior high school could illuminate the effects in their social world of greater capacity for decentration. This capacity is balanced by an opposite and equal egocentrism (Elkind, 1967). An understanding of, on the one hand, altruistic and prosocial behavior, and on the other, antisocial acts would be furthered by

research into when, how, and if the early adolescent develops a societal perspective, i.e., a coordination of all possible third-person perspectives (Selman, 1971, 1976a, 1976b; Yussen, 1976).

(f) Early adolescents draw away from the sphere of influence of their parents into that of their peers. Research into the utilization of the peer group as a support system for educational values would be of interest, particularly among disadvantaged youth. One role of adult leadership may be to intentionally use peer pressure to encourage achievement, as it is done in collectivist societies and in this country by Jesse Jackson of PUSH. The educational climate includes the influence of peers, and obviously affects the acquisition of skills in science as well as other academic subjects.

3. The social causes of youthful alienation. Since the 1960's it has come to the attention of psychologists and sociologists that young people, whatever their origins, suffer alienation and estrangement from the social institutions of this country. Sociologists, if not psychologists, tend to agree on the social causes of alienation (Seeman, 1936) and anomie (Merton, 1949). When humankind loses control of the world it has generated individuals inevitably become alienated from their social institutions. When a large proportion of citizens lack normatively acceptable means of working towards culturally emphasized goals the social system is said to be anomic. When basic economic processes are reified, thus shunting responsibility to corporate persons or to a golem called the stock market, democratic control of the economy is effectively blocked. When constituent economic pressures are reified as Inflation or The Unemployment Ratio or Recession, the resultant mystification renders these economic processes too opaque to approach. Adults as well as youths react to their learned helplessness by estrangement and alienation. But the special status of young people precludes social-structural security thus increasing their vulnerability to anomic social conditions. Certain youths are particularly vulnerable by virtue of their upbringing or personal limitations to an inherent pessimism about the future, and an attitude of learned helplessness. The familial and social causes of such negative attitudes should be the subject of adolescent research.

The component negative beliefs constituting alienation include powerlessness or the belief that one's own behavior cannot determine the outcome one seeks; isolation or the belief that goals highly regarded by society are unavailable or unrewarding; normlessness or the belief that socially disapproved behaviors are required to achieve one's goals; and meaninglessness or the withdrawal of value attribution from one's acts. Common symptoms of alienation are amorality, i.e., justifying any means to the end of success; rigidity or seeking safety in routine and compliance; withdrawal in drug abuse and meantal illness; and terrorism. Estranged youths who reject the Puritan values of self-control, future-orientation, and responsibility may then embrace the positive values of spontaneity, expressiveness, and intimacy. The investigation of adolescent alienation, including its sources and symptoms should be recognized as a national priority deserving of generous funding support.

4. Cognitive style. There is a growing body of evidence that sex and subcultural differences exist in cognitive style. There is now a body of work on biological substrates of field dependence with implications for sex differences (Waber, 1977). In general, males consistently show a more field-independent cognitive style than do females. The sex difference in spatial

ability and presumably field independence is strongly correlated with a constellation of genetic, endocrinological, and neurological factors. Apparently, for example, late maturers of both sexes are better at spatial ability and more field independent and this seems related to greater terminal lateral dominance. Since girls mature at an earlier age, Waber suggests that lateral dominance may be less complete for girls, encouraging field dependence.

Along another line, Mexican American behavioral scientists, despite their small number, have begun an imaginative and constructive attack on the deficit view of cultural difference as it applies to their subculture. Ramirez and Castaneda (1974) agree, on the basis of their own research with the Witkin Rod and Frame Test, that Chicano children are in general more field dependent than Anglo children, but argue that the childrearing style of Mexican American families which encourages field dependence also encourages communal, religious, and family values antagonistic to competitive and individualistic Anglo values. Mexican parents stress obedience and punish aggression because they value in their children different qualities than those valued by Anglo parents. (McCluskey, Albas, Cuevas, Ferrer, & Niemi, 1975). Ramirez and Castaneda argue that for Mexican American children to succeed in school without rejecting their cultural identity, teaching strategies compatible with their learning and lifestyle must be incorporated into the educational system. They offer a well worked out and pretested plan for doing just that. A number of recent studies, some with a culturally integrated staff, have focused upon the distinctive features of Mexican American society. For example, Kagan and Madsen (1971) demonstrated that when rewards could be achieved only if two children working on a task cooperated with each other, Mexican and Mexican American children excelled; when the children were required to compete with each other Anglo children achieved more rewards. In another study, Kagan and Carlson (1975) demonstrated population differences in individual assertiveness, with urban Anglo-American children more assertive than semirural poor children of Mexican or Anglo descent, and semirural poor children from either culture more assertive than rural Mexican children. Holtzman and colleagues (1975) conducted an examplary cross-cultural longitudinal study of school children in Mexico and the United States from which they concluded that Americans are more dynamic, technological, competitive and possess a more complex and differentiated cognitive structure while Mexicans tend to be family-centered, cooperative, and fatalistic. There are, however, very few parallel studies that look for differences rather than deficits in the black community.

Any program of science education will have to take a serious look at the burgeoning literature on sex and subcultural differences in cognitive style.

5. The role of work in the life of young people requires further study. Since work is the central activity through which we participate in society, any meaningful discussion of youth participation must probe the sources, and effects on youth, of unemployment or the fear thereof. Coleman II proposals such as a dual minimum wage and early youthful employment fail to cope with these economic realities. Youths must and will be kept in school and out of the competitive job market until a condition of full adult employment prevails. Adolescent researchers, whatever their discipline, must address the effects on youth of a constricting economy, unemployment and the effects on the individual of artificial controls on professional education. Despite the social need for trained educators, health care workers, lawyers and other

professional personnel, there is an undersupply of such positions for university educated youths. On the other hand, a fraction of the useful jobs in our society are properly rewarded. There may be an overemphasis on status associated with academic positions that interferes with job satisfaction by blue collar workers.

6. The role of discipline in the classroom. The disciplinary problem constitutes an important obstacle to learning in today's classroom. Many early adolescents adopt a pseudo-independent stance, perhaps to compensate for still very strong feelings of helplessness. Adults in authority may then assume mistakenly that the early adolescent is ready for substantial autonomy and withdraw their assertion of authority. Alternative disciplinary measures in the high school class interact with familial and subcultural values in their effects and with cognitive level. Just how requires further study.

By early adolescence, power cannot and should not be used to legitimate authority (Baumrind, 1968). The young person is now capable of formal operational thought. He can formulate principles of choice by which to judge his own actions and the actions of others and see clearly many alternatives to adult directives; the adult therefore be prepared to defend rationally, as to an adult, a directive with which the adolescent disagrees.

For any form of adult-administered youth program to be successful, adults must be willing and able to assert their authority. The recent decline in adult authority may stem more from the reluctance of designated authorities to exercise and enforce it than from refusal by youth to accept it. This reluctance may reflect the difficulty those with power have in distinguishing authoritative from authoritarian control. But even adults willing to assert authoritative control over teenagers find it difficult to do so when social services provided by the community have the effect of undermining their legitimate authority. Legislation allowing juveniles free access to contraceptives and abortion without parental consent is an example of a social policy trend that weakens parent-adolescent bonding and negates the fiduciary obligations adults acknowledge toward adolescents.

Our method of handling juvenile offenders in the schools and community actively reinforces their antisocial choices. To effectively deter, punishment must be sure, swift and justly administered, and desirable alternative outlets should be available. Punishment of juvenile or adult offenders is not sure--estimates of the percentage of crimes that result in imprisonment range between 1% and 3%. Punishment when it does come is certainly not swift. And until very recently the indeterminate sentencing of juveniles rendered punishment entirely unjust. Relatively few children at the postconventional level of moral judgment commit illegal acts. The rest will be encouraged to do so by the absence of swift, sure punishment or social disapproval. Children at the premoral level equate consequences with moral value so that an act that consistently goes unpunished will not even be judged to be wrong. Children at the conventional level will find comfort in adult attention and peer approval for their delinquent behavior.

Typically, high school officials look the other way when youths commit such serious crimes as rape, assault with a deadly weapon and extortion. Yet we know that inaction by observing adults of aggressive acts actually increases the incidences of such acts (Siegal & Kohn, 1959; Spence, 1966). Antisocial behavior in the school and community is frequently rewarded by

special attention and programs while outstanding achievement and good behavior are increasingly overlooked or actually ridiculed as square by adults disaffected with the structure of their own lives.

I recommend research on the interrelations between the onset of formal reasoning, postconventional moral reasoning and legitimization of adult authority in the family and school settings.

IV. Public Understanding of Science

Before engaging in mass education programs, the success of those already in operation should be examined. There is no advantage to distorting science research by oversimplification in order to make it acdeptable. Instead the composition of the audience who watch the superb Nova and National Geographic science programs should be determined in order to see what sections of the population are in fact interested in well-presented programs of science education for the layman.

To what extent do young persons feel that an understanding of physical, biological and social reality would enrich their lives? Do young people know what "reasoning skills" are and does their desire for self-improvement take that form? Do sex and subcultural identifications determine interest? When the target groups have been determined, a program focused on ethics of research with human subjects, and the values of science should be instituted using mass media and community forums.

How does resource depletion impact on the morale and values of early adolescents and other age groups? What segments of our population are psychologically debilitated (lowered achievement drive and morale) by the prospects of resource depletion and a shrinking economy? What sacrifices is the present generation prepared to make for the future and how can energy and economic realities be made sufficiently concrete to impact upon young people in a constructive rather than a debilitating manner? What do our young people think of deception in human behavioral research, genetic manipulation, vivisection in science classes and so on? These are issues which could be discussed and debated in junior high school science classes with the focus on sharpening logical and scientific communication skills.

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Social Science Education of the Early Adolescent: Some Perspectives and Recommendations

O. L. Davis, Jr.

Schooling for the early adolescent appears to be both not as good as many would like and not nearly as bad as some would claim. In many circumstances, for many of these pupils, their schooling is not only adequate; it is superior. Too often, for too many, schooling for early adolescents is not just mediocre; it is mindless. Any easy generalization, thus, likely asserts too much, ignores too much, or credits too little. But what else might be expected in a society that insists that all children and youth attend school? And, more, that all children and youth achieve and, as well, like their schooling experience?

These reflections remind us not to seek panaceas. They console us for attempting greatly while falling short of high aspiration. They suggest that all programs and children will not profit equally nor equitably from alterations in course offerings of organizational structure. They call for us to keep in mind that overemphasis of any dimension of life (and schooling) is to risk being plastic, is to labor toward caricature. They suggest that all that is or has been is not significant or wrong or silly. They further imply that programs for the early adolescents have been seriously pondered and developed as well as capriciously invented and sustained.

Solid improvement of the social science education of early adolescents, therefore, must relate to the world as it is, not some magical kingdom conjured up to disguise the realities which exist. To know that real world is a first task. Certainly, research efforts here are important and must be undertaken. We already know much, however, and approximations can be stated with assurance.

Some Perspectives about special schooling for adolescents

For over half a century, the American education enterprise has fostered special schooling for young adolescents. This schooling, in organizational terms, has always been an "intermediate" unit, inserted between the timeless elementary (or grammar) school and the secondary (or high) school. Even more American in concept than the high school, this intermediate unit not only has been "in the middle"; it has been "caught" in the middle. Pressures may be identified which have sought to build a unique "junior" school as well as to subordinate it as a "junior high" school or to make it an extension of the elementary school. Regardless of age/grade levels included, this special school has assumed features of both the high and elementary schools even as it has invented some, albeit few individual characteristics of its own.

Over most of its history, this special school has been known as a junior high school. Early on and continuing through the years, it was seen as a "transition" between elementary and high school. It provided an interval for exploration and consolidation of courses and skills initiated in the elementary school prior to more specialized, even career-directed (e.g., college, vocation) work in high school. Also, the junior high school early was justified as a vehicle for pupils' occupation training or entry into the labor market.

It was the last required schooling prior to expiration of mandated school attendance. Thus, historically, this special school was seen for many youth to be the school system's "last chance" to "help" them.

Recent years have seen the development of the "middle school" as a substitute for the junior high school. More often a rechristening or a reorganization of the already "one best system", the middle school concept has had a rising popularity. Indeed, some middle schools even built new programs reportedly related to the needs and interests of the youth they serve. Most have not.

Whatever justification is employed, one major explanation for the rapid growth of middle schools must been seen as their utility in many school districts' desegregation efforts. The middle school, by incorporating some former elementary grade level(s) (mainly grade six), make possible downward desegregation while permitting retention of largely segregated (and neighborhood) elementary schools. This political use of school organization has provided an unanticipated opportunity to use the rhetoric invented for the new middle school to create justification for responsible curriculum revision and instructional adaptation.

By whatever name, however, too many programs and too much teaching engaged by early adolescents miss these youth. Or the adolescents turn them off or tune them out. The personal characteristics of these youngsters, while highly varied, are not obscure. For instance, these youth are active as well as fadish. They seek self-understanding as well as understanding of their roles and places, values, and options. They desire to work, to be real and not phony (childish) and frequently are not motivated to confront what adults want them to engage. They appear reluctant to "wait" or "postpone". They are aware that life is hyperbole and they tire from growing so rapidly.

Programs miss these youth not just because of inadequate attention to their individual growth and development. Our research, however inadquate, has not served school people well because of its preoccupation with the individual person, with psychological concepts. Our research on the classroom cultures of these youth is almost non-existent. And educational programs, probably mainly by accident, are consistent with the culture(s) of these youth.

The foreseeable future reveals an increase in middle school organization. Its teaching and administrative staff, unless major change is instituted, likely will be drawn more from a general pool of talent, much like an army requiring riflemen and truck drivers, than from individuals specifically prepared for a special and demanding role. But change is possible and change in teacher preparation and assignment should be a high priority matter. The nature of the educational program will receive some attention as a matter of course; it merits massive, concentrated concern and development. Both teachers and program must have support systems never before available to this special school for adolescents. The "no man's land" of the past must become "someone's land" for the benefit of youth society.

Some Perspectives about social studies in schools for young adolescents

The curriculum of the junior high (and middle) schools appears to be a creature of capricious happenstance injudiciously mixed with rational

deliberation. Perhaps too harsh, this comment. Nevertheless, the school's educational program "just growed." All components of the junior high/middle school curriculum are covered by this broad brush conclusion.

Even so, how could the curriculum not be so characterized. Varied and inconsistent justifications for the school, varied and inconsistent goals, contexts, communities, and talents.

In social studies, the chaos of the junior high school provided one stimulus for Harold Rugg's pioneering social science program in the 1920's. Its impressive and immediate success must be seen as evidence of the need for a deliberate program at this level.

By the mid-1930's, however, a regularity and stability descended on the junior high school program. And it persists today. Traceable to the ligitimizing pronouncements of the American Historical Associations Commission on the Social Studies, American History is a fixture at grade eight and, until just recently, civics was standard at grade nine.

The sequences of most programs are arbitrary even while being rationally justifiable. Moreover, the foci for grades six and seven and, now, grade nine are not set. Most programs are defined by publishers' offerings. Most elementary series include grade K-6 while a few incorporate K-7. Grade eight is reserved for American history and grade nine is "up for students' grabs": sometimes nothing, sometime world geography, sometime world history. Almost never is the social studies program for young adolescents conceived and developed as a sequence (e.g., grades 6-9) and almost never do such programs include attention either to social problems (as in the older "core" programs) or to social sciences other than history and geography.

An important observation here. The major social studies curriculum revision projects of the 1960's largely bypassed programs for young adolescents. True, MACOS has been used in junior high school. One major geography project developed a course for high school pupils and has been offered to many ninth graders. "From Subject to Citizen" was focused at junior high school pupils and was the only part developed of a quite ambitiously designed program. Even including the "Project Social Studies" efforts, the junior high school program was neglected by the reformers.

Or, maybe, reformers realistically judged curriculum reform at this level to have low yield.

At any event, history and geography dominate the offerings to young adolescents. Some economics and political science may slip into the program under the "cover" of history and a little anthropology may be incorporated as either history or geography. Not only is this dominance apparent from materials in use, teachers and parents understand the dominance as correct. Explanation of these observations should be undertaken and these results should aid understanding of the situation. Teachers and parents are not just "traditional" or "stubborn". They are as concerned as others about quality of program; their goals and perceptions must be used in efforts to increase the viability of the programs for the youth.

The goal of citizenship education receives more than lip service. Most teachers and other adults and, I suspect, most pupils would assert or assent to this major aim of social studies. Present programs find easy justification on this point. That citizenship education should include attention to other social sciences (e.g., anthropology) is still an agenda item of the future.

That this goal may be honored by serious study of social problems must also receive direct attention. To note the agenda is not be bemoan past actions; it is to prompt obvious preparation for another consideration.

Some Perspectives
about some other realities
about the status of social science instruction in schools for young adolescents

A major constraint on social science instruction generally, as well as in middle schools, is the accelerating attention given to reading and mathematics skills. These "basic 2-R's" are consuming more instructional time than ever, and more resources and more emphasis (e.g., "accountability" tests). The simple fact is that all other curriculum components, including the social studies, are receiving less instructional time and attention. This prominent fact of life appears unlikely to disappear soon. Even with more time - and certainly with the time available - social studies quite reasonably may be expected to become more "read" than "studied."

Coincident with the "back to basics" movement is the observation that social studies (and science) are low priority areas to the public generally. They are just "not important". This observation underscores not just C. P. Snow's typification of the two cultures - one scientific, the other, humanistic. It may well suggest a tacit acceptance of another set of two cultures - one, elitist and important mainly at perilous junctions (e.g., orbiting of a Sputnik; a total embargo of foreign oil), and, the other, commonplace insistence on minimum "survival" skills (e.g., reading a warranty). The simplism of this latter possibility eats to the core of traditional educational values and, furthermore, would weaken the people's ability to anticipate or respond, and would provide instant scapegoats in the press of unhappy events. Any move to strengthen social studies (and science) in the school must recognize and confront seriously the cultures of mind in our land.

Social studies teaching is largely textbound. So is that of almost all curriculum components. This reality should be recognized as a criterion for materials production and dissemination. That is, text-type materials probably will be more widely used than other materials, especially high technology (e.g., computers). Also, the established, commercial curriculum materials development/distribution system is the system for delivery of the basic materials to the schools for pupil use. Early and intimate involvement of this system in curriculum development efforts should be productive and cost effective.

Paradoxically, social studies teaching usually recognizes the socialization of youth but retards explicit teaching about values. This paradox may be overcome by materials, strategies, and teachers. Most important, the teacher is the key. Yet, the paradox will not vanish with more sensitive, more knowledgeable teachers. Curriculum development must involve local planning and general adult involvement. Too often, community leaders are bypassed until the outrage of citizens vents its fury on a school system (e.g., Kanawha County, WV).

Teachers are concerned about several burdens. One is management. Others include pupils who are classsed as not motivated and a program with too many expectations. Improved teacher education, staff development, and a support systems may help diminish these feelings of impotence. They must be targeted for attention or new emphases have little chance of consideration, much less survival.

Junior high programs appear to have become technologized. Driven by elaborate and extensive objectives, "individual" programs have increased. Pupils going from one LAP to another seem to be taking a correspondence course in residence. Group discussion and projects in many schools are simply things of the past or delusion of frustrated development.

Funding available for instruction is decreasing. The costs of materials are increasing. One inevitable consequence is fewer curriculum materials, or certainly fewer new materials. Other prospects, none especially pleasant, are larger class sizes, curtailed supplies, and decreased instructional support.

Little opportunity exists for young adolescents to work, to engage in real work. Union restrictions and child labor laws are only two of the constraints against legitimate work by youth. This, learning about the world of work (an adult world) consists mainly of reading, some looking (not observing), and, perhaps, simulation.

The prospects for a major change in face of the present circumstances of the economy are not slim; they appear to be none. One legacy of the Watergate era appears to be a sharp decrease in political efficacy and an increase in cynicism. What can I do? So what? Let Jimmy do it? Why doesn't Jimmy do it? Voting doesn't work. Politicians are corrupt - no matter who is elected: the old saw seems too true.

Junior high school courses are organized and scheduled as subjects, subjects presumably relating to underlying knowledge structures (i.e., disciplines). Close examination reveals these courses are at best quasi - disciplinary and severely restricted at that. As subjects, the courses do not "work" for young adolescents. They are remote, perhaps irrelevant, or, maybe important for adults only. Yet, teachers and other adults know subjects even when they recognize that most real social problems (e.g., environment, peace) and issues important to young adolescents are not captive of any course. One reasonable possibility in this complex and tense situation is to reject the "all or none" hypothesis and incorporate in the program of studies <u>both</u> subjects and problems. The core programs of 15-30 years ago are a rich resource of ideas. Attention to real problems should be conceptualized not as a substitute for courses but as both option and coordinate requirements.

In the social studies and probably in some sciences, the middle school is not pupils' last chance. It may be their first chance. Even if not their first, the high school and college, even, may offer additional "chances". Justification of serious initiatives at this level need not claim a "last chance" criterion. Such a rationale should emphasize a "major chance" standard.

Social studies programs are not independent of science nor are they independent from the language arts. Reading, for certain, must be attended in every program proposal. Hopefully, other co-relationships will be sought.

Social studies programs in school do not and cannot be expected to yield results that are needed. Citizenship education is both larger than social

studies and the school. This acknowledgment is not to suggest school coordination of non-school events. It is to recognize the power of the family, the larger community, the media and other forces on youth. School social studies can be improved by this awareness. Conscious attention to some of these forces (e.g., TV) can enhance their positive power. Acceptance of this generalization can relieve the pressure on school social studies to try something it can only fail at the attempt. Too, it can enable conceptualization of social studies to proceed at an accelerated pace and enjoy a creativity too long suppressed.

Some Recommendations for initiatives to improve social studies instruction for young adolescents

Beginning recommendations are made here under several categories. Dollar amounts are not indicated at this time. These beginning efforts, as they prove beneficial, should be expanded over time. Other suggestions will be added to the agenda for improvement.

Teacher Education

1. NSF supported Centers for Early Adolescence. A few (3-5) of these Centers should be established at university Schools of Education to become exemplary settings for teacher education programs, in-service staff development resources, and curriculum development settings. Each Center should be part of a network of colleges and universities as well as a network of school systems. Also, each Center should seek, using institutional and other resources, to become comprehensive with respect to programs for young adolescents. That is, Centers should be expected soon to include, in addition to science, mathematics, and social sciences, other curriculum components (e.g., reading, art, vocational education) and other resources important to concerns to early adolescence (e.g., psychologists, anthropologists, school administrators). The Center would provide early and deliberate focus on pre-service teacher education programs for young adolescence.

2. NSF panels on teacher education and staff development for early adolescence. At least two national panels (pre-service teacher education, staff development) should be convened to give comprehensive, prestigious leadership to obvious needs including certification. NSF funding would support partially this endeavor, but other groups, including professional societies (e.g., NSTA, ASCD, NCTE, NCSS, AACTE) should contribute a portion of the expenses of the panels.

3. Through the Centers for Early Adolescence, NSF should establish some pilot activities for local initiatives from established teacher centers and school districts. Such initiatives should recognize the necessity for continuing and renewing education of both experienced and new teachers.

Curriculum

For curriculum development programs, several important principles are advanced:

- Networks of schools with responsible leadership should be encouraged to adapt/invent needed curriculum materials. At the beginning, such networks

should be related to the Centers for Early Adolescence described above. Clearly, the principles of local initiative and teacher involvement must replace the practice of "handing down" the courses which are conceived (and were often labeled) as "teacher proof".

- Attention must be given both to nature of knowledge (both inside and outside disciplinary boundaries) and to uses of knowledge (applicative, associative, interpretive, replicative). Programs must proceed from both subjects, at times, and from problems, at times. Anticipated uses of the knoweldge will suggest instructional formats, strategies, and evaluation.
- Programs must attend early to dissemination including formats and costs from commercial publication to delivery.
- Programs must be "practical" to teachers: credible, low cost - in time and energy, and provide alternatives to personal "fit". Otherwise, adoption of new materials is inhibited.
- Some programs must be related closely to "real life" as known by young adolescents.
- Most programs components must have "familiar" format and/or content elements in order to enhance use.
- Programs should include small steps away from conventional materials, not leaps from the present to more exciting programs. For example, oral history is both an appropriate historical methodology and an authentic field work procedure from anthropology. Its use can be related to existing program, increase pupil activity, and foster motivation. Too, programs should provide some emphasis to far away and near in place (e.g., food costs and geographic conditions in U.S.; the shrimp industry) and past and always recent...and sometime future.
- Focused emphasis should be provided in programs on
  - culture study: distant and nearby (e.g., Algerian rural/city life; Mexican American life in south Texas);
  - thinking toward problem resolution (not problem "solving");
  - living now and the foreseeable future (e.g., attention to law and to real work (e.g., colonization: Spanish colonies in New Mexico and Greek colonies in Italy; social experiments: free election, prohibition; fullness of a time: early 1940's; wartime - but not only wartime);
  - skills (e.g., reading social studies materials, gathering information, developing appropriate report, using index).

1. Development by teachers with leadership of small-scale materials (i.e., lesson length, inexpensive) to be tried out and made available to other teachers in network schools. The Vancouver (B.C.) Environmental Education Program is a constructive model for these types of activities.
2. Development of materials having both local and more wide-spread usefulness. Here, for example, would be included short films (e.g., The Hinojosa Family at Work), slide/tape presentations (e.g., "Interviewing Aunt Teresa".), and transparency sets (e.g., growth of Austin and growth of nearby towns over years). Important here would be generalized "rules" or "experience" which could guide other groups/individuals' preparation of similar materials.
3. Development of "modules" or units that provide possibility for both comprehensive and alternative organizations in programs of studies. These materials might be for use in quarter-length segments or as short as week-long

episodes. They might focus on only in-school or out-of-school activities or some combination of in- and out-of-school setting. The materials, in time, should fit into a matrix of possibilities to be a special NSF-supported project.

4. Curriculum development for school years/levels over the middle school years/range. Support should be given for the development of rationales and basic plans for a sequence of middle school "courses" in social studies, science, and mathematics. Explicit consideration should be given to opportunities for co-relation as well as studies independent of other areas of the curriculum. These initiatives may be expected to yield a variety of program designs and related components. By involving publishers, early estimates of "produceability" and marketability may be available to guide subsequent decisions about intensive development.

Patent, Other Adult Involvement

In all programs, attention must be given to informing parents and other adults in the community about program developments. Some programs will be organized to emphasize quite deliberately the resources of the community outside the school setting.

1. Parents and other adults must be helped to become aware of the issues, problems, and concerns for social science and the possibilities of new program components. NSF support could develop a handbook of design options with examples which might include television and radio spots, tracks (not unlike those prepared by many church groups), radio talk-shows, conferences, booklets, and community networks of adult groups (e.g., unions, service clubs).

2. Program materials, on many occasions, should directly involve parents and other adults in school-related activities. Two examples are the Philadelphia schools' project on rituals and the Argus program on television and the law. Both require parent and child/youth collaboration on school projects at home; a new type of home "work".

Out of School Opportunities

1. Centers for Early Adolescence, school districts, and professional associations/societies should initiate collaboration between network television and radio and school programming. Times seem propitious for such collaboration; networks are under fire for programming. NSF support might be minimal for such pilot efforts.

a. Collaboration would yield more and more timely materials for in-school and out-of-school for major single programs and mini-series. An example of such materials are the guides developed recently for Holocaust and disseminated in part by the NCSS.

b. Some new programming should be considered. The success of "Sesame Street" in an obvious stimulant for special programs for early adolescents.

2. Directed attention to out-of-school opportunities should be given by prestigious panels and by local authorities. "Priming the pump" should be productive in building options.

Research

1. Initially, a conference on Needed Research on Social Studies for Young Adolescents seems to be an early priority. This conference probably

should be held under university sponsorship with NSF funding. Most participants should be individuals presently recognized in the social studies education research community. Others should include individuals with substantial background in research on teaching, human development, learning, social anthropology, etc.

2. Establishment of a research component in the NSF-funded Centers for Early Adolescence. These major Centers should have a research component, funded for substantial work. The Centers, then could enlist general university talent for their programs.

3. Deliberate collaboration with NIE Centers and Laboratories. As the Centers for Early Adolescence become operational, communication links should be developed with the several NIE supported Centers and Laboratories. This kind of effort should encourage the emergence of a general community of ecucational research relating to early adolescence.

4. Establishment of a research grants competition. Research on social studies for early adolescence likely will be accelerated by a large scale research grants competition. The history of the USOE Cooperative Research Program reveals that competition not only supported many projects, but it provided a context of nurturance of educational research. An open research grants competition for studies of young adolescents and schooling (certainly in sciences, social science, and mathematics) probably will multiply solid research efforts manyfold.

5. Research training. Some NSF funding should be targeted for research training. Here, program guidelines should not be as rigidly enforced as earlier USOE programs. Researchers possessing high level empirical methodologies are clearly needed. On the other hand, many researchers are needed who possess mainly historical or ethnographic backgrounds.

Early Adolescence and the Science Curriculum

Paul DeHart Hurd

The issue

Unrecognized, underprivileged, and undereducated describe the early adolescent in the American school system. Reforms to improve the teaching of science in schools over the past twenty years have concentrated on the elementary school (grades K-6) and on the high school (grades 9-12). Only recently has some attention been given to the middle grades science curriculum where the early adolescent is enrolled.

The issue is broader than a concern with the teaching of science in junior high schools; it involves the whole question of early adolescent education. Since the late 1940s, junior high schools have been subjected to searching criticism and reappraisal by educators and the public. In 1960 James B. Conant directed his report on junior high schools to school boards, with recommendations for changes in focus and curriculum. The Association for Supervision and Curriculum Development (NEA) in 1961 responded with a publication titled The Junior High School We Need. Whatever the source of criticism, the consensus was that the junior high school had failed as a "transition" institution between the elementary school (a time for learning the "basics") and the more academically oriented secondary schools. Other commentators viewed the failure as a failure to meet student needs--social, psychological, biological--in the period of transition from childhood to adolescence.

For more than 20 years the educational program of the junior high schools has been under pressure to change. The changes have been few, student and curriculum problems have become more disturbing, and the need for reasoned and positive action is a concern of teachers and parents alike.

Underlying conditions

1. School organization. The schools early adolescents attend are organized in a variety of ways. The junior high school is a three-year school comprised of grades 7, 8, and 9. Grade 9 was added to the elementary school program in 1910 to reduce the number of early school dropouts. The idea of combining grades 7, 8, and 9 into a distinct school division, housed in a building set apart from elementary and senior high schools soon followed. Currently about 50 percent of the students in the 7-8-9 grades age group attend a junior high school. The remaining students attend schools organized as a combined junior-senior school (6-6 plan), elementary, middle, senior schools (4-4-4), combined elementary-secondary (K-12), intermediate schools (grades 7-8), traditional pattern (8-4), and middle schools. The current middle school organizational movement began in the early 1960s, and by 1978 it is estimated to include 8,000 schools. The grades included in these middle schools vary; there is always a 7th and an 8th grade; about 25 percent of the schools include a 6th grade and none the 9th grade.

   Perspective: Our attention should focus on the appropriate education of of the early adolescent. Adaptation to a school organization will need to be considered at some point. If we must choose a grade level organization the middle school is currently the most likely place for change, but the junior high schools enroll more students.

2. Teachers of early adolescents. Science and mathematics teachers for the junior high school years are seldom educated to teach at this level In

most states teachers certified for high school are automatically approved for teaching any of the grades 7 through 12. Typically, certification for the elementary school means approval for teaching in grades 1 through 8. Most teachers in schools including grades 7 and 8, but not the 9th grade, are trained as elementary school teachers. Only a few have science minors or majors, and their background for understanding the early adolescent is a course in child growth and development. A high school certified science teacher will have a major in a science (usually biology) and may have had a course in adolescent psychology though this is not common. Middle school or junior high school teachers typically have done their student teaching at grades lower or higher than 7, 8, or 9 because supervising teachers consider these grades too difficult for a beginning teacher to manage. Experienced teachers in urban areas avoid assignments to grades 7, 8, 9 if possible.

Junior high school teachers are sensitive about their status in the school system; the term "junior" may have something to do with this. They also feel they do not fit anywhere in the educational profession. Professional association in science are either elementary school oriented or for secondary school teachers. The Junior High School Science Quarterly ceased publication in 1932. Attempts are now being made to initiate a M/JH Science Bulletin (issue 1, February 1978) which consists of two columns in The Science Teacher Newsletter of the National Science Teachers Association.

The professional preparation of a junior high school principal is usually that of an elementary school or a high school principal.

Perspective: Any school program or related activity proposed for education of the early adolescent will need to be accompanied by an effective inservice education program for teachers and administrators.

3. The science curriculum. Science textbooks are written as a series extending from grade 1 through 8, or as a series for grades 7, 8, and 9. In addition, there are a number of science textbooks written especially for grade 9.

The most common course offering at grade 9 is general science. This course was originally developed in 1915 and includes topics from a range of science, meteorology, chemistry, and physics. The original purpose of general science was to arouse a student's interest in taking the discipline based courses offered in high schools. In recent years, 9th grade general science has been in part replaced by discipline based courses such as life science, physical science or earth science.

The three-text science series for grades 7-8-9 are essentially general science books, although there is a tendency to emphasize life science in grade 7, physical science in grade 8, and earth science in grade 9. The grades 1 through 8 series of texts have a thematic, sequential, hierarchical organization in which the same concept is explored several times over an eight-year period, each time at a presumably higher cognitive level.

The rationale underlying science curricula for the early adolescent is viewed on one hand as a capstone to elementary school science and on the other hand as preparing students for high school science. Two new, three-year, innovative science programs, with financial support from the National Science Foundation, have been developed with a consideration of the interests and cognitive development of the early adolescent in mind. These programs are: Probing the Natural World and the Human Sciences Curriculum Program. Both programs have a

modular organization and provide the student with learning options. These options provide a means for accommodating variability in interests and cognitive development among early adolescents.

Perspectives: a. The science program for the early adolescent should be specific for this age group in terms of rationale, goals, and curriculum. The rationale, goals, and curriculum have yet to be defined.

b. The science curriculum should be designed in terms of what is known about the congnitive, affective, moral, social, and biological development of early adolescents.

c. The science subject matter for these courses should be considered in terms of its personal and social importance as well as contributing to scientific enlightenment.

4. Instruction and the early adolescent. This is a topic of considerable debate at the present time. On one side there are critics who feel that the schools have defaulted on their resposibility to educate when they 1) allow students to study whatever they wish (defaults the idea of a curriculum); and 2) overemphasize individualized instruction (minimizes the responsibility of the teacher and neglects value of systematic learning). The central issue is one of assuring continuous progress in learning on a number of desirable fronts. On the other side, teachers respond by 1) pointing out the great diversity among students (therefore the need to individualize instruction); 2) calling attention to the low levels of interest and motivation for learning on the part of the student (student response is better and discipline less a problem if students can choose what they want to learn); 3) noting that absenteeism is so high (especially in inner city schools) that plans for systematic learning on a class basis do not work.

Perspective: The issues behind the problems of instruction are related to unclear or inappropriate goals for science teaching, unclear notions about learning and instruction, inappropriate curriculum materials, and perhaps shifts in our culture.

5. The student speaks. When emerging adolescents are asked what they would like to know, their answers center around themselves (health, sex, being happy), relations with peers and parents, and life in general (social concerns). They are interested in the natural world, but more in the way of a naturalist rather than of a research scientist. They like "to do things" in learning such things as experiments and projects. They do not dislike science but are not particularly enthusiastic about it either--"it all depends upon the teacher." They respect teachers that "make you learn," but would like to have something to say about what they "have to learn."

Perspective: It seems reasonable and possible to develop instructional materials that appeal to the interests of early adolescents, that are scientifically valid, and that are likely to improve learning effectiveness.

6. The science educator view. Traditionally the appropriate science curriculum for the early adolescent has been a problem. The condition reflects the lack of a viable rationale for considering emerging adolescence as an age group for special educational concern, the lack of conformity in school organization for the age group, and the lack of any central professional structure through which to work. The middle school movement, though muddled, offers a means by

which changes in curriculum might be introduced. The school people responsible for the movement are at least aware that things are not going well in the education of the early adolescent and they appear to welcome help.

Currently there are efforts to reconceptualize the teaching of science at all levels of education from the elementary school through the undergraduate years of college. The middle/junior high school might well be the most favorable place to introduce a new science curriculum and the supportive teaching practices. Some of the central questions now being considered in planning new directions for science teaching are: How can we improve the adaptive capacities of young people for living in a science/technological society where so many persistant societal problems require a knowledge of science for their resolution? How can people effectively use the accumulated knowledge within the sciences for personal decision making and self-management? These objectives carry with them the need to consider values, ethics, and morals in teaching science. Understanding the nature of science, the significance of technology, and the interrelation of science and technology seems imperative in a new curriculum. Science in the intellectual use of leisure also seems to be a desirable objective for the teaching of science. Not to be overlooked is the fact that outstanding scientists first identified their interest in science while in the middle grades.

Perspective: a. To accomplish these and other goals for the teaching of science to early adolescents will require a major transformation in the present curriculum. The context of the curriculum will likely be societal rather than discipline based. The subject matter of the curriculum will probably be of inderdisciplinary nature and selected for its general usefulness in life and living rather than to display the structure of scientific disciplines.

b. Process skills would be developed as much or more so in the exercise of decision making as in fostering inquiry. To know sources, how to organize, and how to make use of reliable knowledge adds new dimensions to science teaching.

c. It is difficult to conceive of a problem oriented science course in a social context where decisions are required that can not avoid a consideration of values.

d. Instructional procedures, to reach a high level of effectiveness, should be consistent with the goals of instruction, assumptions about learning, and broadly the nature of the early adolescent. In turn this means there is considerable work that needs to be done to translate research finding on cultural change, learning, and development into school practices.

e. Curriculum resources should be extended to include more than the textbook and the knowledge a teacher possesses and include those of the community, human as well as natural and institutional (museums, zoos, exhibits, etc.).

There is the question of whether we know enough about curriculum design, learning, the character of early adolescence and teacher education among other things to bring avout desired educational changes. Can we accommodate the range of cultural differences found in large city schools with a single science program? How do we deal with deficiencies in basic skills, particularly reading, that students have at the time they enter the six or seventh grade? These and many other questions will need to be explored for new insights into the development of an appropriate education in the sciences for the early adolescent.

Preliminary Recommendations for Science Education Programs Emphasing Early Adolescents

The complexity of the early adolescent as a person and of the school setting in which this person is educated suggests the need for a comprehensive program of efforts on a broad front if favorable educational changes are to be accomplished. The educational problems of the early adolescent are partly the result of a weak knowledge base about early adolescence and partly a lack of clarity about desirable science education goals. Bringing about significant changes in the system will require a holistic view and a unifying focus of research, study, development, and practice.

Recommendations:

I. Awareness Conferences. $500,000.

Conferences and symposia on the early adolescent; educational needs, state of the art, programs, projections.

Type A. School administrators, science supervisors.

Type B. Grades 6-10 teachers, parents, education directors of museums, planetaria, acquaria, nature camps, etc.

Type C. Science educators (National Association for Research in Science Teaching (NARST); science teacher educators (Association for the Education of Teachers of Science (AETS); editors and advisory board members of science education journals (The Physics Teacher, Journal of Chemical Education, American Biology Teacher, The Science Teacher, Science and Children, The M/JH Science Bulletin, School Science and Mathematics, Science Education, Journal or Research in Science Teaching, ERIC/SMEAC).

A structure for these conferences to be developed emphasizing issues, problems, individual needs of early adolescents, and science curriculum rationale and goals. An appropriate report to NSF to be developed following each conference, and a similar report for distribution to participants and other interested persons.

A 3-5-year funded program.

II. Symposia on Early Adolescence and the Science Curriculum. $75,000.

Type A. National, regional, state, and local science teachers organizations such as, NSTA; AAAS section Q; NABT, NARST, CASMT, state science teachers associations, Middle School Assn., ASCD, school administrators organizations, etc.

Type B. Reporting of research and sessions on needed research in early adolescence and in the learning of science, at meetings of AERA, APA, NARST, etc.

Publishable reports are expected from these symposia.

A 3-5-year funded program.

III. Teacher Centers. $2,000,000.

Establishing school based, college/school cooperative centers for the the professional development of science, mathematics and social studies teachers of early adolescents: a modification of the NSF Pre-College Teacher Development in Science Program. These centers would differ from the present program in three aspects; they would: 1) be school based; 2) be teacher directed; and 3) stress professional attributes (learning about the results of research on early adolescents, developing interdisciplinary curricula, developing community resource guides for informal education in science, etc.). In addition, teachers would have opportunities to acquire a relevant background of knowledge about science and technology. A school-based teacher revitalization program will have an advantage for attracting the participation of school administrators and parents in its activities.

This would be a long-range project for the next decade--the first year or so pilot programs to be supported in possibly a large city, a rural area, a suburban school system, an Indian school. It will be necessary to provide some outside services to schools to help in getting started on a program as well as some follow-up and evaluative services. This program might be a cooperative effort with USOE, with NSF developing the science/math./social science resource materials for the teachers' professional development.

IV. Information Dissemination in Early Adolescence Education. $500,000.

Two information exchange centers in early adolescence should be piloted. These centers preferably located in a college or university, would serve as depositories for publications and curriculum materials, serve as a coordinating agency, and produce newsletters and catalogs of materials. Another activity under this program would be the support of special issues of educational journals featuring science education for early adolescence (about 20 journals would be relevant to this activity).

There is need to establish a network of communication channels for materials on early adolescence. A preliminary study should probably be made of the effectiveness of the U.S.O.E. Dissemination Network and of the ERIC/SMEAC Information Reference Center.

Need also to explore the possibility of establishing small reference libraries in early adolescence and science teaching in the teacher centers. (Somewhat like AAAS Science Library packages for students developed in the 1960s.)

V. Research in Science Teaching/Early Adolescence. $2,500,000.

Three types of research programs are envisaged: synthesis, basic, applied/evaluative.

Type A. Synthesis studies. There is need for a clearer knowledge of the existing data base on early adolescence and on science teaching for this age span. Examples of needed synthesis studies are NAEP testing of early adolescents, Project Talent information, and the exploration of other known data banks; psychological, social, moral, and biological development. There appear to be useful studies done as basic research in various disciplines that need to be brought

together especially from medicine, cultural anthropology, sociology, psychology, etc. Included here would be a comprehensive survey of science teaching conditions, practices, curriculum course offerings, etc. for grades 6-7-8-9. An ongoing pattern of synthesis studies is needed to get some coordination of research efforts and practice.

Type B. Disciplined Inquiry. The focus would be on directed research that has a demonstrable or logical relevance to science teaching for early adolescence. This research is likely to be more fruitful if it is done by transdisciplinary teams with a membership comprised of scientists, educators, psychologists, sociologists, medical specialists, anthropologists, or combinations as defined by the problem under consideration and the choice of appropriate methodologies.

There is also a need for teams of specialists qualified to identify and interpret research from disciplines related to educational practice. For example, there appears to be more knowledge about learning and retention than appears in the education literature. The changing image of humankind (quality of life concepts, self-concepts, life styles) is being explored by cultural anthropologists, sociologists, and others. The single concept that human beings are now responsible for their own evolution has enormous educational implications.

Type C. Evaluative research directed at question answering and problem generating could serve as a means of coordinating basic research and directing its application.

For all three categories of investigation final reports or summaries need to be interpreted at several levels of consumer sophistication.

Somewhere in the basic research program provision should be made for long-range longitudinal studies of educational attainment resulting from differing practices and in terms of various goals for the teaching of science.

VI. Graduate Fellowship Program in Early Adolescence and Science Education. $200,000.

This program would be open to three categories of researchers: 1) science educators, 2) science supervisors; and 3) researchers in cognate fields of science education. The goal is to develop a cadre of competent researchers that can deal with problems associated with the teaching of science to early adolescents.

There should be opportunities for the typical science educator who does research to learn more about early adolescence, and the behavioral scientists should have an opportunity to learn something about science education. The science supervisor needs to acquire sufficient skills in educational research to assist in the conduct of research and to be competent in interpreting research findings to others.

VII. Curriculum Development for the Early Adolescent. $1,000,000.

Development of science curriculum modules for grades 6,7,8,9 that are goal directed and interdisciplinary in subject matter. These modules should be team developed involving teachers, parents, scientists, educators, and behavioral scientists. Cultural and learning validity to be reflected in the formative evaluation. The curriculum development team could be school, district, state, or regional based. Copies of all materials produced to be deposited with a science education curriculum exchange.

Guidelines for proposals should emphasize the importance of developing modules that harmonize with a stated theory of science education.

VIII. Out-of-School Science Education Programs for Early Adolescents. $500,000.

One purpose of this program is to develop a firmer continuity and a reinforcement of efforts between informal and formal science education experiences. A second purpose is to foster the integration of school/community life.

The direction for funding is to out-of-school agencies with science oriented programs, such as, museums, zoos, nature organizations, science camps, planetariums, observatories, etc., to develop educational programs for early adolescents that are in harmony with the overall goals of science teaching.

In this program schools would be encouraged to develop community resources guides (agencies, institution, human resources, etc.) that now exist. Proposals for the development of out-of-school resources would be encouraged, especially the development of resources in which students and parents could participate in the development.

IX. The Exceptional Student Program. $1,000,000.

Two types of research and development endeavors are envisaged here, one a compensatory program, and the other a program for the gifted and talented student. The science teacher in the middle grades shares in the responsibility for helping to alleviate educational deficiencies acquired in lower grades and in fact may be in a favored position for doing so, particularly in mathematics and reading.

While considered effort was devoted to science programs for the gifted and talented two decades ago the whole endeavor suffered from the lack of an adequate conceptual base.

Programs for the handicapped--blind, deaf, physically limited, home or institutional bound--would be dealt with in the exceptional student program.

No attempt has been made to spell out details for these programs. There are over-lapping areas and functions and this is viewed as desirable. The programs as a group represent an all-out effort to exert an educational transformation for the teaching of science to early adolescents. For the first year or two in each program the efforts may be more exploratory than directly productive and this should be recognized from the onset. Crucial for each of these programs is the finding of ways to effectively report results, achievements, experiences or whatever so that there is some evidence of progress or failure, and to identify needed research and study.

Perceptions Relating to the Education of Adolescents

Fred D. Johnson

Perhaps at the risk of oversimplifying, it is my contention that adolescent education historically has never had a fair shake in the American education plan. In most instances, it has simply been an extension downward of the typical American high school. The instructional strategies, methods of evaluating, and so forth, related to it have been synonymous with those of high school instruction based on the Carnegie unit without any consideration given to the social and emotional development of students who fall in this crucial chronological group.

The financial and human resources that have been committed to improving education at this level have been overshadowed by other crises or educational priorities. As we look at a series of pertinent skills that are imperative for survival and are prerequisites for specialized learning and career selection, we realize that students who are at this transitional age have not historically been given and are not presently being given ample opportunity to acquire these skills. For example: frequently, after the primary training, students are taught by people who are highly trained in a particular discipline. Instead of having an opportunity to learn important skills (for example: identifying, classifying, analyzing and synthesizing). Students are forced to use these skills without the help of the teacher or others. Without doubt, these are the most difficult skills to acquire and are germane to any future educational growth and development.

The pre-college educational community has forced itself into a dilemma by having conveyed to the public that we can quantify the educational growth of a student, his ability to reason, and other characteristics. Perhaps this is one of the great myths that has been created in American education. The writer argues that the cadre who emphasize "back to basics" are doing so in most cases in good faith, in that they too walked down the corridors of the American school.

Our educational system is based on the concepts of essentialism, meaning there is a body of knowledge, skills and values that is essential for all to learn. Additionally these essentials are governed by a time limit. That is, each student should show "X" amount of material in a certain period of time. Available research data indicating emphatically that the learning style, learning rate, and learning ability of each child are different has been overlooked continuously.

The essentialistic approach to education prevails at all levels. From the beginning of the school experience through high school the emphasis is on the completion of the secondary program. The system has its reward and punishment - a grading system with many fallacies, one of which is that it has pretended to be able to measure the educational growth and achievement of students. Yet neither the public nor the educational community seriously questions our present system of evaluating students. Only rhetoric is given to comprehensive student evaluation.

To meet with any real success in instituting change, all endeavors involving students must have the basic goal of improving and maintaining the students themselves. We should make the capabilities and the aspirations of

of the individual the prime considerations in planning the school program.

In our evaluation attempts, we must give recognition to the fact that persons perceive improvements in different ways. Also, in every lesson there are planned outcomes that we attempt to measure, but little attention is ever given to unplanned outcomes, which may be positive or negative in themselves. It is imperative that the student in the school have compatible perceptions of what constitutes improvement.

Students in the transition or adolescent period are usually involved in either the junior high school or the middle school. These institutions are spoken of, in some instances, as being one and the same; however, there is a distinct difference between them. The middle school is more oriented to the needs of the students; whereas the junior high school is directed more to specialization within a discipline. Students of this age group are curious and eager to try new things. They are more interested in experimentation and less oriented to the academic areas. The present school experience for students at this age level usually does not take advantage of the students' interest in discovery nor their need for recognition.

The fact that the middle school or the junior high school experience is not a period of exploration leads to frustration and poor career choices on behalf of far too many students. Not only should students be given an opportunity to explore during this period, but also it is a crucial time when the interdisciplinary nature of knowledge can be and should be emphasized. This should also be a period in which the school experience emphasizes a large number of "hands-on" opportunities for students. In an age of technology and technological gains it is imperative that students understand and be introduced both to the world of work and to the lifelong necessity of making adjustments based on these technological and societal gains and changes.

The ineffectiveness of higher education institutions in equipping teachers with expertise and appropriate teaching techniques at the junior high/middle school level further complicates the matter of educating the early adolescent.

School boards and school administrations do not give adequate attention to the needs of the early adolescent. This indictment should not be made without an explanation: the numerous pressures exerted on the school boards and administrations cause the special needs of the early adolescent child to rate a low priority. The funds, staff time, and experimental resources necessary to improve the middle school experience are not available; consequently, local boards and school administrations do not have the financial resources, and the private sector is not willing to commit the necessary funds in order to carry out the research and experimentation that is necessary in order to improve the school experience for these students. Hence, the writer feels it is imperative that the federal government and other granting agencies build a strong case for the needs in this area and commit the resources necessary in order to guide education. Some experts estimate that only one out of every five jobs in this decade will require a college degree; however, approximately one-half of all jobs will require some training beyond high school and perhaps retraining before the student retires. This makes for an even stronger case for equipping the student with the proper skills in order for him to cope with his and our ever-changing society. Providing young people with temporary jobs is just a "short-run" solution to a serious political and economical problem.

What is needed is that education address itself to the funding and development of long term education and training programs that will aid students during their natural period of exploration and provide opportunities for them to experiment and make good career choices. At this stage of development critical thinking and problem solving skills are developed. These areas cannot be fully developed in the traditional elementary classroom or in the departmentalized junior high school dominated too frequently by one adult.

The curriculum of the adolescent learner should be planned in such a way that it meets the needs of the student both academically and socially and still provides for continuous progress.

Perhaps the greatest deterrent to a successful school experience for the adolescent learner is the fact that faculties are not properly trained to deal with their instructional programs. Teachers should have special training and a desire to work with this age group. They should also be committed to pupil-centered teaching. Teachers at this particular level should be especially sensitive and possess a high degree of perception. The school experience at this level should neither be remedial or preparatory. Emphasis should be on the utilization of knowledge rather than just a mastery of it. The program should be planned in a manner that all students are encouraged to make continuous progress. The evaluation and grading should be done on an individual basis rather than on a comparative basis. Appropriate affective indicators should be used in the evaluative process.

The school experience for these students should stress motivational activities rather than just the acquisition of specific facts and skills. It should encourage the utilization of various techniques and programs, many of which, though presently used in our schools, are inconsistent with the needs and interests of the students in this age group and in other age groups as well.

The total environment is an exceedingly important aspect of the students' learning plan; this includes the attitudes of the staff as well as the physical cal environment. One aspect of this environment should contain "love" - defined as respect for the forces of life. Creativeness and experimentation should be encouraged. The environment should be arranged in such a way that learning has certain prescribed goals. The total program should become as failure-free as possible. Frequently, the school experience produces failure, thus establishing a pattern for life that is failure-oriented, a factor which perpetuates a negative self-image.

STATEMENT

Extensive new curricular efforts in science, math, and the social studies for the early adolescent are not the answer in terms of meeting the educational needs of students at this level. The curriculum development efforts in this area, however, are commendable. Many of the programs developed for this particular age group should be applauded in that they take the social, emotional, and educational needs into consideration prior to the development efforts. Despite the development of these excellent materials, numerous other pressures have inhibited (perhaps prohibited in some cases) the implementation of these programs. For example: there are the pressures from many high schools at this grade level; the lack of commitment on school boards and

administrative personnel; and frustrated teachers with improper training for dealing with students at this level. As with most programs, dissemination models nationally are ineffective. Hence, when we look at the other needs for improvement of the education of students at this level, curriculum development would certainly have a very low priority.

RECOMMENDATION

Resources, both human and financial, should be included in inservice teacher training in order that the population of teachers who are affected in this area might be much greater than the routine preservice teacher training program. These inservice programs should be of a cooperative nature between school districts and NSF with the university serving in an advisory capacity. An agreement to provide funds in this area on a cooperative basis could serve as a motivational look in convincing school administrations and teachers that they should make strong commitments.

STATEMENT

The minority adolescent student is confronted with all the previously mentioned problems plus a series of other societal problems that appear to be impeccable at this junction. The writer would argue that no special curricula should be written for minority students. What is needed is a strong commitment from teachers, counselors, administrators, and the lay public in terms of exhibiting an interest in and a concern about the growth and welfare of these students. The development of special curricula usually has negative psychological connotations. Regardless of the good intentions, it is a way of labeling students, with which they are far too familiar. The money that would be used in curriculum development would far better be spent in human resources being administered to students during and after the school day. It could be suggested that the statement relating to curriculum development applies to female involvement in science and science-related activities as well.

RECOMMENDATION

Funds should be provided to reward teachers, counselors, and other personnel who write strong proposals and make firm commitments to provide activities for and spend time working with minority youth other than school hours. Provisions should be made for travel for students in these proposals.

STATEMENT

From a practitioner's vantage point, there has been a dichotomy between so-called "inquiry science" activities and commensurate evaluative procedures. Research is needed, and the development of activities that are not dichotomous with inquiry instruction needs to be designed and implemented. Far too frequently, curriculum projects succumb to pressures from administrators, the community, and other groups and destroy viable programs and projects in an effort to quantify the gains in cognitive terms. Frequently, unplanned positive outcomes are latent. Skills and knowledge acquired through unplanned activities are rarely taken into consideration in the process of assessing student growth and achievement.

RECOMMENDATION

It is recommended that funds be allocated to conduct research to determine ways of implementing those findings which tend to measure other aspects of educational growth rather than cognition alone. (Federal efforts including National Assessment, evaluative criteria for Title I, and other Federal projects do not encourage the kind of evaluation which considers the comprehensive evaluation of students).

STATEMENT

A large number of middle school/junior high teachers have not had training which explains the characteristics nor the uniqueness of the way that the adolescent learns. To further complicate this matter far too many of these teachers have not been trained to teach science, math, and social studies in a manner where the interdisciplinary nature of these disciplines is exemplified. These subjects are taught as if they are totally independent of each other. Hence, these teachers are not able to direct an instructional program for students in a manner whereby the students are guided toward an understanding of the interrelatedness of these disciplines. They do not know how to pull excerpts from existing science, math, and social studies program and teach them as a unit; nor are they able to capitalize on activities which are appealing to the adolescent.

RECOMMENDATION

The teacher training programs that NSF may finance should include training in the psychology of the adolescent and strategies for teaching in an interdisciplinary program.

STATEMENT

In order to meet the minimum requirements of state departments of education and accrediting agencies, frequently teachers may be teaching in, for them, an uncertified discipline, and all the science and/or math may be farmed out to other teachers except for one course of math and/or science. These "misplaced" teachers frequently have no interest in these courses and are simply teaching them because they are forced to do so. The certification laws in many states will allow teachers to teach one course out of their area. These kinds of arrangements allow for very poor science and math programs especially at the middle school/junior high level.

RECOMMENDATION

In any program that the National Science Foundation sponsors the local school district should not be allowed to farm out one or two courses of science and/or math to teachers who are devoting the majority of their instructional time in other areas.

It is recommended that the funds available for adolescent education be spent in the following manner:

Research and Development	20 Percent
Teacher Training Programs	50 Percent
Minority Programs	20 Percent
Formal Education	10 Percent

Perspectives and Recommendations for the Science Education Directorate

Joan Scheff Lipsitz

Introduction

> "I don't think science should be what it is. It is always the course where a teacher stands up for the whole period and lectures. You should have some activities that are fun, not like looking at amoebae under a microscope and doing a worksheet on it or dissecting frogs. That's so gross."
>
> Seventh-grade junior high student

It is wise to listen to young people. They tell us in several sentences what we struggle for years to clarify for education policy. This twelve-year-old asks for a radical change in the quality of the teacher's interaction with the students. He wants to become involved through meaningful activity in exploring aspects of science that are not trivial to him. He wants the activity to be pleasurable and to have a purpose beyond the completion of a pedestrian worksheet. His concern for the integrity of living things, most probably for his own body, makes it impossible for him to know why he is dissecting frogs. The act is too threatening, or "gross". He obviously has no vision of what "science" is beyond the assignments in a mundane classroom. No matter how long he talks, he will not mention the social sciences or mathematics, nor will he discuss concepts. He will probably not even mention a single fact that has excited him in the classroom. At home, on the other hand, he avidly learns the facts in the Guinness World Book of Records, reads every latest almanac, argues heatedly about the morality of the neutron bomb, becomes fascinated with the migratory patterns of birds, and reads every magazine article about puberty that he can find in his older sister's fashion magazines.

Early Adolescence as a Target Area

Early adolescence is the second most rapid time of growth and change in human development. Only infancy exceeds early adolescence in velocity of growth. Physically, young adolescents are experiencing the adolescent growth spurt and the onset of puberty. They have special health, nutritional, and mental health needs in relation to these physical changes. These needs have curricular implications. Emotionally and socially, young adolescents are exploring a sense of uniqueness and belonging, of separation and commitment, of future goals and their personal pasts. For the first time in their lives, they see themselves as having a personal destiny and a social destiny. For the first time they see themselves as being a part of a generation. Again, these have curricular implications. Intellectually, young adolescents are exploring values and ideas in a new way. Some are beginning to form abstractions, to generalize, to think about thinking. This intellectual development makes it possible for some to become engaged with concepts, imagery, theorems, contingencies, and implications. It also enables them to shift from an

authoritarian sense of right and wrong to a more open and complex approach to value formation, both personal and social. This cognitive shift makes it possible for young adolescents to struggle for the first time with conflicting concepts like individual rights and "the greater social good" -- the underpinnings of democracy. This change in cognitive style has import for curriculum and teaching techniques.

And so, early adolescence is a critical time in human development, critical to the individual and to the social order. We tend to be fearful of this stage of development. While acknowledging the plasticity of this stage, we anticipate that young adolescents are more receptive to negative than to positive influences. We are frightened that the great majority who maneuver their way successfully through a time of life requiring considerable coping skills will "catch" the "diseases" of our "new epidemics" -- pregnancy, running away, dropping out, alcoholism, drug addiction, violence, and suicide. I do not mean to belittle the personal pain or social risk of such behaviors, but rather to insist that most young adolescents, for many reasons, most of which we do not know, manage to cope with amazing stability through so demanding a period in life. Partly because of our fears, we label the age group as "transitional" and put young adolescents on hold. By so doing, we fail to assign our talents and financial resources to an extremely vulnerable and impressionable age group.

Were our decision-making processes rational, we would examine the physical socio-emotional, and cognitive characteristics of early adolescence, conclude that the needs of the age group are both critical to human development and widely ignored, and select early adolescence as a target area for federal funding across a broad spectrum of research and program initiatives.

Contexts of Adolescent Development

Adolescents mature in environments. Although we tend to talk about the power of intrapsychic forces and see children entering puberty as being at the mercy of hormones, socio-historical, cultural, and institutional contexts help to define the nature of adolescence. To be a young person going to school in a society dependent upon books for knowledge but having meaningful experiences within the context of family or community was to be someone with a defined role dependent upon school for curricular content. Now, in an information-rich society that offers few family and community roles for adolescents, the demands made upon schooling to help with role definition are socially determined. Likewise, to grow up in the Depression when each adolescent had to contribute to the well-being of the family conferred a sense of meaning to development quite different from the affluence of the '50s and '60s, and different still from the constricting economy of the '70s. To be young, black, 14, and anticipating a 40% unemployment rate is to have a foreclosed future at the very point of self-definition and rising social consciousness. Adolescence, insofar as it is externally defined, is extremely vulnerable to economic forces. When school curricula are devised that are insensitive to that vulnerability, they become irrelevant to the lives of students. We tend to think that many young adolescents will not learn because of the innter static caused by biological change, while ignoring the external static caused by the lack of synchrony between institutional demands and socio-economic realities.

Nor will curricular revision suffice. Young people grow within the contexts of institutions: the family, schools, medical centers, the juvenile justice system, the media, libraries, voluntary youth organizations, shopping malls, etc. Because we are unsure what role we want young adolescents to assume in our society, most of these institutions are not infused with a sense of purpose that helps young people to define themselves as parts of a larger whole. What is to be learned in school therefore remains an artificial construct unrelated to any sense of purpose for too many junior high age students, and unrelated to that network of institutions that each young adolescent must learn to negotiate.

The context that presents us, in the 1970s, with the hardest sets of choices is racial and ethnic. At a time when school classes are not to be "racially identifiable" and yet ethnic and racial groups choose not to be "melted", policy setters for schooling for all grade levels face a dilemma that is yet to be resolved. The conflict appears to be most keenly felt by young adolescents who, unlike other age groups, thrive when they are in the racial majority. Thus, while black students do best in predominately white elementary and high schools, they appear to do better in predominately black junior high schools. Similarly, while elementary and senior high school students do better with more experienced teachers, junior high students appear to achieve more with inexperienced teachers. What we may be seeing here is the self-consciousness and peer-orientation of young adolescents, who relate best to young teachers closest to their own age in socially comfortable contexts. From various studies a picture emerges of the vulnerable seventh-grader, more vulnerable than others to violence, the unsettling effects of changing schools, damage to self-esteem, and heterogeneity of school population. We can choose to reject certain policy implications of such findings, but we must decide how to respond to them as best we can through institutional restructuring, hiring policies, instructional methodologies, and curricular offerings.

We must also finally recognize officially that adolescents do not live their lives in the isolated fragments of the individual institutions we choose to specialize in. Although the impact of spending 180 days a year in a school building is not to be minimized, information and experiences from the various institutions that an adolescent interacts with are processed by one integrated personality who, we hope, does not live as fragmented a life as our curricula and individual institutions presume.

The Junior High School

The junior high school is an overloaded institution. Staffed by the least appropriately trained administrators and teachers, often under-funded by inequities in school finance weighting formulas, hindered by dated or insufficient curricular materials, junior high schools are supposed to instruct the most developmentally variable group of students in any of the continua of public schooling. In a society not sure what the aims of schooling should be, uncertain who young adolescents are and who we want them to be, junior highs add insult upon injury by lacking an internal definition of what the aims of schooling are for young adolescents in particular. These areas of confusion converge upon an age group just beginning to seek personal and social definition.

In North Carolina, to take one state as an example (North Carolina is now this country's 11th most populous state, about to become the 10th), it is almost impossible to find out where 12-15 year olds are in school. Doing so requires a school-by-school count. In 1976, 12-15 year olds were housed with 26 different grade configurations (e.g., K-8, 7-9, 7-8, 5-8, etc.). It is difficult to argue that we have any consensus about what schooling should be for young adolescents when we obviously place them where it is most convenient to place them administratively. They have become the most expandable and therefore the most transferrable age group.

Because the lack of fit between organizational structure and students' developmental needs is so great at the junior high level, it is difficult to make a rationale for any curricular or staff development independent of structural change. When one reviews the objectives and funding priorities of NSF from 1954 to the present, one can easily recommend that every single priority be reassigned now to junior high education. The fact that they have all been attempted at other grade levels does not minimize the importance of these objectives for young adolescents. It is possible that no meetings or position papers are necessary. (I was, in fact, tempted to list recommendations culled from "pre-College Science Curriculum Activities of the National Science Foundation," Vol. II, and submit them in lieu of this paper.) The problem with such an approach, however, is that it is unclear that any funding priority targeted to an unresponsive organizational structure will be effective. We are seeing some exciting concepts of career education and consumer and homemaker education bastardized at the junior high level. Can we be at all assured that science education will fare better?

Recommendations

These general assumptions form the basis for the recommendations that follow:

1. The ways in which young people are taught to convey as much, if not more, lasting means as the subject matter being taught. Young people who spend more than one-third of their waking hours in an accepting environment that values their individuality and their growing abililty to assume responsibility for their lives are given a chance to learn that they are worthwhile, resourceful human beings. Any movement toward curricular innovation in our schools affords us the opportunity to extend our commitment to create human learning environments. We must resist the superimposition of yet another program onto the school day of a young person in a coercive, irrationally untrusting, or unduly regimented environment.
2. Teachers need humane working condidions if they are to create humane environments for their students. The special demands already made upon teachers of young adolescents need to be considered in any proposed curricular or instructional reform.
3. Schools by themselves cannot redress the wrongs of our society. We have learned many hard lessons about the feasibility of asking our educational institutions to take on the solitary burden of healing our social and economic wounds. Efforts at expanding the populations served in schools should be extended beyond schools to other educational institutions and settings.

The following recommendations are made in the context of these general assumptions and the review of what preceded them:

1. Funding should promote the integration of minority and women students into the regular science classroom, rather than targeting and thereby separating out specially funded students. (Too often categorical funding creates separate categories of students and excludes them from the mainstream.)
2. Funding should promote school reorganization in the direction of recommendations emerging from middle school associations. These include interdisciplinary studies, high interest short term courses, options or electives, and other attempts to give students and teachers more choice and flexibility.
3. Funding should promote the development of curricular modules at various levels of cognitive sophistication to meet the needs of a variable young adolescent school population. These modules should be developed so that they can be used in heterogeneously grouped class. (Too many curricular packages require homogeneous grouping and are therefore not useful to schools where homogeneous grouping leads to in-school segregation, or what OCR calls "racially identifiable" classes. Teachers at the junior high level seek excellent materials for classes of students with broad ranges of ability and background.)
4. Funding should encourage established and newly organized teacher centers to serve middle schools/junior high school staff members. (Most established teacher centers do not offer services to teachers of young adolescents.)
5. Initiatives in science literacy should be joined to initiatives in basic literacy so that science curricular development and instructional improvement address the problems of functionally illiterate young adolescents and their teachers. (It is almost impossible for teachers to learn how to teach subject-related literacy skills to adolescents either in university courses or during in-service workshops.)
6. Funding initiatives should extend outside the school to the voluntary sector, including the media, recreation departments, voluntary youth-serving organizations, industry, shopping malls and other places where young people congregate. (In Scandinavia, creative uses of shopping malls as centers where teenagers "hang-out" are being explored.)
7. Programs that parallel the artists-in-the-schools project should be funded for those science areas supported by NSF. Young adolescents need greater access to role models rather than learning about careers from textbooks.
8. No curricular development should be funded without strong dissemination and instructional improvement components.
9. Information disseminators should be encouraged to broaden the scope of the content and clientele of dissemination. Dissemination should not be tied solely to products, nor should it be limited to science educators and researchers.

10. Instructional and administrative improvement should receive the highest funding priorities. The vast majority of teachers and administrators at the middle school/junior high level have had inadequate pre-service preparation and in-service work. Money will be misspent on curricular revision without major emphasis being placed on professional improvement.
    a. Funding should be made available to state departments of education to upgrade their science consultants in the areas of early adolescent development, the organization of the school day, interdisciplinary teaching, science literacy, etc.
    b. Funding should be made available to colleges, universities and non-profit private institutions to improve or establish pre-service and in-service course offerings that emphasize early adolescent development, interdisciplinary approaches to science, etc.
11. Funding should be made available to non-profit education and/or advocacy institutions that are in the vanguard of educational reform at the state, regional, and national levels to establish demonstration programs that provide training, information services, and to establish liaisons among professionals in the schools, community workers, and the private sector with the purpose of expanding science opportunities for young adolescents in the community and the work place.

Career Education

Barbara Preli

Career Education is a term that has generated nationwide discussion over the last few years. Professional literature documents the evolution from concept to fact. A fact which sees itself being implemented in over 9200 school districts throughout the United States.

Just recently, the Congress of the United States enacted into law the National Career Education Incentive Act which was signed by President Carter on December 13, 1978. This act with adequate appropriation will see the concept of Career Education implemented in every school district throughout the nation.

- What exactly is this concept that has generated such phenomenal interest and enthusiasm from educators, parents and business labor-professional community? What effect does this concept have on the areas of science math and social studies?
- How will this effect the early adolescent?
- How does this fit into the goals of the National Science Foundation?

I would hope the following narrative would suggest some answers to each of these questions.

Career Education, from its beginning, emphasizes for all persons, at all educational levels, in all settings of our society the need to know, understand and act on the increasingly close relationship between education and work that exists in our society.

Community surveys, research studies and professional literature speak frequently of the occupational illiteracy that is strangling our youth. Whether such criticism is justified or not, data indicate a majority of students are leaving the system with:

- lack of employability skills.
- limited job seeking, getting and keeping skills.
- limited knowledge of available occupations.
- limited recognition of values and rewards of work.
- limited decision-making skills.
- little awareness of the purposefulness of education to the world of work.
- little adaptability to change.
- limited ability to make long range goals.
- limited ability to form positive attitude about self.

Data reflect the need for strengthening these areas with all students and at all levels of the program beginning in the formative primary years and continuing in a systematic developmental process throughout the students development.

Very basic questions which present themselves at this time are:

- How can these needs be met?
- Where does this fit into the present educational system we are familiar with?
- Who should do it?

School systems throughout the United States are currently successfully demonstrating a variety of different approaches to making these goals a reality for students. It is too time consuming to detail all the approaches being utilized but there are certain commonalities among all programs. Career Education:

- involves the entire school program and the resources of the community. It is for all students, at all levels of the school program.
- is an integral part of the total education enterprise.
- is a continuum of planned experiences which begins in early childhood and continued through the adult years.
- infused, threaded or woven into the content of existing curriculum. It is not packaged as a separate course or series of courses.
- is a systematic developmental concept which encompasses three phrases.

Awareness - This is the foundation of the career education program. It provides the basic foundation in the areas of academics, work, self, concept, decision-making, and community.
Awareness is a continuous process throughout one's life.

Exploration - Exploration builds upon the attitudes and skills developed in the awareness phase. It provides additional skill training, both academic and technical, hands on experiences, greater self-analysis, and in depth exploration of jobs to enable the student to choose a preparation best suited to his life plan.
Exploration is also a continuous process.

Preparation - This phase prepares the student, based upon their selection of programs, to enter college, to obtain a job, or continue in a post-secondary training program.
In addition to the preparation of skills, it gives the student further exploration of skills, further exploration of those occupations which utilize the skills he is learning.

Specific curriculum design varies among programs. The elementary component usually centers around creating an awareness of the students towards the world of work, self, school, and community in a sequenced and developmental process. The career concepts, themes and techniques are interwoven among the curriculum as to be a regular part of the teaching/learning process.

The middle/junior high component of the process provides young adolescents with the motivation to think of future career decisions at a time, when they

In order to answer these questions we must first clarify terminology. The United States Office of Education defines Career-Education as "an effort aimed at refocusing American education and the actions of the broader community in ways that will help individuals acquire and utilize the knowledge, skills, and attitudes necessary for each to make work a meaningful, productive, satisfying part of his or her way of learning."

It is necessary to underscore the emphasis placed on preparation for the world of work, (paid, unpaid) does not compromise the other goals of education. Career Education is not designed to solve all the problems of education, but to refocus education on one of its goals, preparation for work, as part of the total educational endeavor.

The definition can be further clarified by examination of the learner goals proposes by the United States Office of Education.

- Increased self-awareness
- Increased basic academic/vocational skills
- Increased awareness of work values
- Increased awareness of knowledge about work
- Improved work habits
- Increased work getting and seeking skills
- Increased placement
- Increased awareness of means for continued education

Career Education addresses itself in a systematic manner to each of the above outcomes.

Analysis of the learner outcomes makes it apparent that many persons share the joint responsibility for achieving these goals with children. The specific role or responsibility may differ but all contribute in many inter-related ways to the student outcomes.

Teachers		SCHOOLS
Counselors		Instruction Guidance
Librarians		Vocational Education Special Education
Principals	CAREER EDUCATION GOALS	Research & Evaluation
Supervisors		
School Board Members		
Parents		Home-Family
Business-Labor-Professional-Governmental Persons		Community

The delivery of Career Education represents a collaborative effort of the total instructional staff along with assistance from the home family, and broad community. This is only achieved if all persons involved in the total development of the child work together to mutually implement the student goals.

are concerned with the present. The revised curriculum emphasizes the relevance of content to careers. Intensified guidance efforts and opportunities for exploration of the world of work are provided.

The senior high program is a more formalized program of preparation. Awareness and exploration are still continuing for some students. A revised curriculum emphasizing the relevance of content to careers, guidance activities and part time work experience are generally available in varying degrees.

Career Education blends a variety of techniques that are already familiar to many educators. The easiest way to clarify these techniques is to provide a short description.

Interview

A class or individual questions workers about their job. It is an excellent means of research, listening, inquiry, and communicating. Students participate in:

- locating pre-interview information
- formulation of questions
- conducting the interview
- follow up activities

Research

Research about the world of work can be conducted by every student at every grade level. The amount and mode of research depends upon the characteristics of this individual child.
Research can be accomplished in many ways; written reports, interviews, films, and filmstrips, recordings and tapes, books, charts, letters, newspapers, magazines, commercials.

Discussion

Discussion is a useful tool for planning activities, problem solving, attitude and value clarification about the world of work. The teacher creates an aware, free, accepting atmosphere. The students should feel free to express their views in an appropriate manner. Guidelines are established before each session begins. Teacher lecture and student-teacher-student exchanges are avoided.

Bulletin Boards

Bulletin Boards serve to focus attention, stimulate thinking, and display student activities. A career bulletin board should reflect the career theme or career value.
Any of the following general themes could be developed for a specified subject area or classroom, e.g.:

A Rainbow Of Careers _____
The Many People Who Work On _____
5-Star Careers _____
The Wonderful World O' _____

What Can You Cook Up For a Career_____
What Are The Educational Requirements?_____
Careers In_____
Spread The Word About_____Be A_____
Consider A Career In_____

Field Trip

A field trip is an excellent way to gather information about the world of work on a first hand basis. It could be an initial or illuminating activity. Workers can be viewed in real-life settings as they carry out their daily roles and responsibilities. Experiences should be carefully planned by the class in advance. Questions should be developed to bring purpose to the trip. A special emphasis needs to be placed on persons in the jobs.

Hands On Activities

Hands on activities are those activities that which entails actually performing those tasks which a worker would do in a certain occupation. These activities are conducted in a simulated situation. Hands on activities give the students an opportunity to associate skills necessary to perform a certain job with their own interests, talents, and capabilities.

Learning Centers

Learning centers are special areas designed for individual and small group learning activities. Learning centers can be used in a variety of ways depending upon the teachers purpose:

1. Total learning environment
2. Remedial work
3. Drill
4. Interest activities
5. Enrichment activities

A career theme can provide an excellent motivational theme for each of these purposes, e.g.: Interest centers of tools can provide some hands-on experiences for children.

Shadowing

This provides the student with a chance in a structured, planned situation to spend time observing a model or models carrying out their daily duties on the job. It presents work in a real life setting. Skills and qualifications can be analyzed as well as interests and talents examined.

Internship

The internship program is a non-paid experience for secondary students in a job area of their choice. The amount of time may vary. It provides students with opportunities to:

- explore the day to day, hour to hour, duties and responsibilities of a job.
- acquire knowledge of other jobs related to their job choice.
- observe the career lattice within a job area.
- interact with a successful role model.
- participate in hands on activities.

Simulation

Role playing provides opportunity for the students to act out a work situation and to examine carefully their interests. A game of charades could be played. Cards can be prepared with pictures of workers with or without a few suggestive comments on tasks performed by the worker to give students an idea for the role play situation. Students can draw and then role play the worker for others to guess.

All of these techniques emphasize a more activity-centered approach to the teaching/learning process - one where students are actively but constructively involved in the process of learning with strong emphasis upon the relationship between education and the world of work.

For purposes of this panel the remaining part of this paper will be directed towards the early adolescent, the middle/junior high years. The particular needs of this age group as relates to Career Education will be explored.

The middle/junior high phase of Career Education includes awareness, exploration and in some individual cases preparation. This phase is a crucial link in the career education process. Some persons have suggested for too long it has been the missing link.

By the time students reach early adolescent, they are ready to explore career areas but are not ready to choose a specific occupation. The exploratory experiences provide an environment for them to determine how their interests can relate to future goals. They can begin to plan their life goals. Research data would indicate that most students are developmentally ready to begin this planning process.

Students, at this age, are activity oriented. They like to learn how to do things, to manipulate, to explore. They have begun to discover that they have opinions and that what they do and say has an effect on other people. Career Education provides the student an opportunity for a trying out period about the world of work within a safe environment of the school and community.

Career Education at this level can provide a key motivational factor for the middle/junior high curriculum. It provides activities which enable students to perceive education as being purposeful and meaningful at a time when students do not generally view school as such. With the introduction of Career concepts within subject content areas students begin to see a

direct relationship between what they are learning and the real world. A sample illustration would be:

Mathematics:

Skills: Measurement
Understanding linear measurement: line segments, English units, perimeter use of protractor to classify angles.
Understanding angle measurement: protractor, classification

Behavioral Objective:

Develops skills and understanding relative to linear measurement and angle measurement. Job cluster: construction, fine arts, and humanities; job family: carpentry, masonry, art; jobs: surveyors, draftsman, architects, artist, landscape artist, builders, engineers

Career Objective:

After participation in activities which provide information about occupations within selected clusters the student will be able to identify tools used, education and training, work hours, reading and math skills, different jobs have different environments.

Facilitating Activity:

1. Develop an eye catching display of various instruments used in measuring lines and angles in different careers (e.g., a T-square protractor, tape measure, yardstick, compass, surveyor's tools). This should be done two or three days before beginning the unit.
2. Begin the unit by relating the instruments on display with the people who might use them.
3. Put up a bulletin board entitled "Good Measurement Skills Can Be The Key To Your Future." Have the student cut out want ads from the daily newspaper for all jobs which require some type of measuring skill throughout the duration of this unit.
4. Develop several hands-on job experience projects for small group work.
   a. This might include surveying a piece of school property, drawing it to scale on paper. Giving length, width, perimeter, angles of the corners.
   b. Within a given time limit assign work crews to build a fence around the school building or football field. Each group will need to submit a bid for the job. They must determine:
      1. Where they will build
      2. The type of fence
      3. The perimeter of the area to be fenced in
      4. Height of fence
      5. Where to put gates
      6. Cost of the supplies from catalogues, or by visiting and calling local stores for this information

7. Each group will turn in a final bid for fencing in the school property, along with a scale drawing to determine which group will be given the job.

5. Relate how people work together, through discussion of how a building is constructed. Surveyors, draftsman, architect, contractor, engineers, builders, landscape artist.
6. Interview someone from Activity 5.
   a. Have speaker bring in some of the tools of his/her trade.
   b. Relate how his/her job involves working closely with others in this cluster.
7. Work sheet - a set of word problems including hypothetical projects to measure and find cost.
8. Ask the school art teacher to explain how perspective and distance are used in art.
9. Classroom resource center for exploration: magazines, kits, books on building.

These types of activities provide opportunities for students to look at themselves specifically as relates to:

- attitudes toward work
- perceptions of own abilities and interests
- skills to assess the variety of job related information they are discovering

Through all of this Career Education provides young adolescents with the motivation to think of future career goals at a time when they are mainly concerned with the present.

SPECIFIC RECOMMENDATIONS:

The following recommendations are suggested within the context of Career Education and the early adolescent.

1. Analysis is needed in the content areas of science, math, and social studies basic skills and concepts and the related job areas. What jobs require these instructional skills? Care should be taken to include jobs across the continuum unskilled ..... professional.
2. Research should be conducted as to the relationship between course selection and projected career goals. Included should be how great is the influence of parents, peers, teachers on course choice.
3. A curriculum development effort should be undertaken to refine the math, science, social studies programs which have proven effective to include work values, job information and career concepts as part of the subject content.
4. Demonstration programs should be conducted which utilize science education and science work related experiences within the community.
5. Research and analyze of job projections for the future as relates to science, math, social studies.
6. Seminars which would develop an awareness on the part of administrators, curriculum developers, teachers, and teacher trainers as to the importance and process of including career concepts within the teaching/learning process.

7. Any program development for the early adolescent should be a part of the total continuum of learning for the student.
   - on a K-12 ..... developmental basis (what comes before and after)
   - what else is going on at the early adolescent years.

   Total program planning rather than isolated subject area development.
8. A directed effort is needed to make science education curriculum alive, exciting and exploratory for all students.
9. While special programs should be continued for gifted and talented students in these areas, additional programs should be developed for ALL students. A LIFE SCIENCE approach. e.g. pollution, energy, physical and mental health. Science education for all as part of development.

Strengthening Mathematics Programs for Early Adolescents

Eugene P. Smith

Background

The Adolescent

The ages from 10 to 15 are important pivotal years in the mathematics education of the growing adolescents because:

1. they are moving from the developmental level Piaget characterizes as the Concrete Operational Stage (ages 6-7 to 11 or 12) where physical manipulation of objects play an important role in thinking to the Formal Operational Stage (ages 11-12 and up) where they can use relational thinking and abstract thought in the solution of problems.
2. the youngsters move in the mathematics curriculum from the relatively informal experiences in arithmetic to the formal structure of algebra and geometry.
3. an understanding, enthusiastic, knowledgable teacher can make the spark for learning mathematics that resides in each of them burst into a flame that may last a lifetime but a poor teacher may come close to snuffing out that spark.
4. the youth reach grades seven and eight that have long been recognized for their barren curriculum--too often simply a review and minor extension of the mathematics of grades one through six.
5. they complete the usual required sequence in mathematics and begin the elective mathematics program or no mathematics at all.
6. the students make the decision to continue studying mathematics and thus keep the doors open to professions such as scientist, engineer, economist, business man, physician, statistician, computer programmer, mathematician, and other occupations requiring a knowledge of high school mathematics for prerequisite courses or the profession itself. Inversely, they may make the decision to avoid high school elective courses in mathematics and thus shut the doors to the professions listed above.

Teachers

There are very few teacher education programs in the United States that are specifically directed toward preparing mathematics teachers for middle and junior high schools. Teachers with secondary mathematics majors tend to gravitate to teaching in high schools. Hence, the middle and junior high school mathematics teachers, in general, have less of an academic background in their subject than the high school teacher.

The problem is compounded by the changing population. For at least the next decade the decreasing numbers of students in American schools will result in shrinking teaching staffs. Hence, there will no longer be the infusion of large numbers of new young teachers pumping fresh ideas into our schools. Reeducation of aging staffs will be critical to the improvement of existing programs.

Minorities, Women and the Handicapped

The numbers of people from the ranks of the minorities, women and the handicapped who major in mathematics or a field such as engineering that requires an extensive knowledge of mathematics is low compared to their representation in the general population. Reasons for this fact are not clear.

Problems Needing Attention

Teacher Education

Middle and junior high school teachers of mathematics, without a doubt, have the most diverse backgrounds in mathematics of any segment of teachers in American schools. Some have undergraduate majors in mathematics, but the preponderance of these teachers in the pre-ninth grade programs have neither majors nor minors in mathematics even though they may be full-time mathematics teachers.

RECOMMENDATION 1. ($5,500,000)

In view of the situation described above it is proposed that the NSF sponsor:

1. Summer institutes in mathematics education for experienced middle and junior high school teachers. These institutes should be planned and implemented with a balance between content and methodology. (There is evidence to support the thesis that teachers tend to teach as they are or have been taught.) The institutes should be followed with curriculum and methods seminars during the academic year.
2. Academic year institutes for experienced middle and junior high school mathematics teachers.

The following additional guidelines are suggested for the inservice institutes:

1. Mathematics content: Follow CUPM recommendations for the mathematical education of junior high school teachers. Special emphasis should be placed upon the mathematics of the rational numbers, geometry including analytic geometry, number theory, elementary statistics, and elementary probability.
2. Curriculum and methods seminars:
   The primary foci should be on teaching techniques, materials of instruction, learning theory, organization for instruction, motivation and problems arising in the day-to-day teaching in the classroom.
3. Participants: Teams of two or three teachers or administrators from a school should be given priority over a single teacher from a school. (See "Dissemination" also.)

4. Dissemination: The administrators and teachers in schools wishing to send a team to the inservice institute should sign an agreement to focus on the inservice education in mathematics of a majority of the rest of the staff teaching mathematics in the school. The leaders of the in-school inservice would be the team from that school in cooperation with the university staff.
5. Stipends: Payment of teachers and leaders in the in-school inservice programs should be in accordance with NSF guidelines.
6. Evaluation: Base line data on achievement in mathematics should be secured in the participating schools. A followup study of the achievement of students should be used as one measure of the effectiveness of the institute programs. The teachers should evaluate the teacher education dimension of the program via a well-designed questionnaire. There should also be followup classroom visits by university personnel conducting the inservice institutes.
7. Proposals: There should be cooperative development of proposals between school systems and a university with evidence of extensive preplanning on the identification of needs, through surveys, and achievement test data.
8. Priority: Initially, priority should be given to teachers from large cities.
9. Materials and equipment: materials and equipment used in the inservice institute such as Cuisenaire rods, fractional parts, kits of teaching aids, calculators and so on should be supplied to each teacher. A set of each should then be given to the teacher for use in classroom instruction.

The rationale for proposing the two types of inservice institutes whose participants are from urban districts include:

1. Minority groups are concentrated in many of our large cities.
2. In general, mathematics scores on the National Assessment of Educational Progress tests have been lower for children and youth in our large city populations than for those in suburban and rural areas.
3. The Miller Math Program in California indicated that when inservice education was instituted, achievement scores improved.
4. We know all too little about what really goes on in classrooms according to a recent study by a committee of the Conference Board of Mathematical Sciences, the NACOME Report. Hence, work with teachers in their own classrooms is felt essential to the success of an inservice program.
5. We have a crisis in the education of the youth in our large cities that must be attacked with vigor and imagination.
6. Beyond the student, the teacher is the most important variable in the mathematics classroom.

The academic-year institutes would have characteristics similar to the inservice institutes.

A special note should be made here of an important omission from the NDEA of 1958. Colleges and universities having both undergraduate programs in mathematics education were excluded from receiving funds for buying materials and equipment. Yet all of the undergraduates and a large number of inservice teachers participate in such programs. Funds should be provided

for the universities conducting the inservice and academic year institutes to buy a wide variety of materials and devices to teach mathematics to the 10 to 15 year-old group.

Materials and Instructional Development

RECOMMENDATION 2. ($1,400,000)

NSF should support the design, development, and testing of innovative sample textbook materials.

New, imaginative, creative textbook materials need to be developed for the early adolescent based on what we know about child development, children's interests, and mathematics as a discipline.

We have already referred to Piaget's Stages of Maturational Development. Bruner says that we have three ways of knowing: enactive, iconic, and symbolic. All too often the enactive way, so important to the elementary school child, is bypassed when it should not be. Piaget's observation of the concrete operational stage and Bruner's hypothesis of the enactive way of knowing imply that it is important to use physical materials to teach mathematics. Furthermore, some researchers, including Dr. Goffrey Matthews of Great Britain, have hypothesized that many youngsters remain in the concrete operational stage well beyond the age of 12 and hence need concrete, manipulative materials to aid their thinking processes in learning mathematics.

We should also recognize that mathematics is "two-faced." With one face it looks out into the world outside the classroom and has its applications in the real world as well as to more advanced mathematics. With the other it looks to its own coherent, intertwined, internal structure. Both of these faces are important and should be emphasized in new materials. But what constitutes an application for the early adolescent? Do the uses of mathematics in sports, in roadmap reading, in studying statistics about birds and four-footed animals, in analyzing statistics about themselves, in making and interpreting graphs and charts serve as applications to the early adolescent? Do the uses of mathematics in studying the relations of odd, even, and square numbers; the figurate numbers (triangular, square, pentadonal....): magic squares and the generation of new magic squares from a given magic square constitute applications of mathematics for the early adolescent? Do applications to the world of work and business interest the early adolescent? Some schools and authors have developed mini-courses and modules around a central theme such as roadmap reading to motivate young minds. In any new materials produced, attempts should be made to appeal to both boys and girls and to minorities as well as the majority race.

In the development of curricular materials during the 60's adequate attention was given to the internal structure of mathematics. Not enough attention was given to applications of the Queen of the Sciences. Practically no attention was given in the widely publicized programs to the interests of children and youth and to the ways they structure knowledge for themselves.

In the 70's a great deal of attention has been directed toward a definition of the BASICS. The National Council of Supervisors of Mathematics, recognizing the responsibility of the profession to define the basic skills,

have published the "National Council of Supervisors of Mathematics Position Paper on the Basic Skills" pursuant to a contract with the National Institute of Education. They identified the following ten basic skill areas:

1. Problem solving
2. Applying mathematics to everyday situations
3. Alertness to the reasonableness to results
4. Estimation and approximation
5. Appropriate computational skills
6. Geometry
7. Measurement
8. Reading, interpreting, and constructing tables, charts and graphs
9. Using mathematics to predict
10. Computer literacy

To these I would add:

11. Knowing when to use each operation
    The calculator as a tool for solving mathematical problems reemphasizes the importance of knowing when to use each of the operations.
12. Mathematical thinking applied to non-mathematics situations
    Euler Circles and Venn Diagrams can be used to test the validity of syllogisms. The chapter on "Proof" of the Twenty-fourth Yearbook of the National Council of Teachers of Mathematics (NCTM) outlines strategies of probable inference and necessary inference that can be applied in both the mathematical and non-mathematical domains. "The Nature of Proof", the Thirteenth Yearbook of the NCTM, is the description of an experiment to provide transfer of mathematical modes of thought to problems of everyday life.

New materials could be judged on the basis of this list of the basics.

Career Education

RECOMMENDATION 3. ($100,000)

NSF should support the design, implementation and testing of realistic and understandable career education materials related to the mathematics needed for the world of work including that needed for entering post secondary programs that lead to the various professions or jobs as technicians. ($100,000)

Newspaper columnists and others have shared true stories of the mathematical deficiencies of high school graduates, especially from schools in the cores of our large cities, about their lack of knowledge of the world of work and its requirements, and the unrealistic wage expectations of school dropouts who learn skills through Job Corps programs. For example, two Texas Job Corps graduates who had learned to weld would not accept a wage approaching $50.00 for an eight-hour day because the pay was too low!

The student who expects to enter a program for training technicians or the college-capable student expecting to enter one of the professions must make decisions on elective courses in mathematics at age 14 or 15. He/she needs information in the early adolescent years to provide a sound basis for selecting courses appropriate to personal long-range goals.

New curriculum materials must be directed to all students not just students in the upper quartile of ability. If this is not done, the new programs will end up in suburban schools and the critical needs of the great bulk of students in our major cities will remain untouched by them. We must find ways to make mathematics relevant to the urban child.

On the other hand, there also should be opportunities for the gifted in mathematics. Possibilities for keeping these youngsters at their learning edges include independent study leading to acceleration, mathematics leagues for interschool competition, open-ended problems in text materials, mathematics clubs, and long-term research projects culminating in a presentation at a mathematics fair or science-day competition.

Issues

There are several issues and problems related to this paper and to the improvement of mathematics programs for the early adolescent youngster. Some of these are listed below:

1. Inservice institutes. If the inservice institute proposal in this paper is accepted, then should the program be planned for the teacher with definite and relatively severe deficiencies in mathematics or for the most capable teachers on the staff? (Since the proposal includes the suggestion that the program participants conduct inservice work in their own schools, the latter group of teachers seems most logical. However, if that portion of the proposal is rejected, then the issue must be faced.)
2. Statistics. What is the place, if any, of statistics in the mathematics programs for the early adolescent? Under the able direction of Frederick Mosteller a Joint Committee of the NCTM and the American Statistical Association produced four volumes entitled Statistics by Example. The first two volumes of this series could be surveyed for ideas.
3. Proof. Should students be introduced to formal proof before the formal geometry class in grade 10 or 11? If so, how? (For example, in considering areas of the rectilinear figures and the circle there is a logical chain of "informal proofs" using physical materials moving from the square to the rectangle to the parallelogram to the triangle to the trapezoid to the circle. (Other logical sequences are also possible.) Some foreign countries introduce simple formal geometric proofs at an earlier age than we do in the USA. There are also "nests" of theorems that could be used in elementary algebra.)
4. Calculators. Should teachers encourage students to use calculators in solving mathematics problems?
5. The computer. Should the computer be used in teaching mathematics to students in the early adolescent years? If so, then should it be used for computer-assisted instruction? computer-managed instruction? producing randomly generated sets of exercises with a different set for each student? simulation? teaching programming techniques?

6. Competency-based programs. Should competency-based mathematics programs be encouraged? Barry Mitzman in an eight-page report on "The Problems of Minimalcy" says that Oregon, the first state to adopt minimum-competency requirements for high school graduation, may also be the first to get off the bandwaggon. (Barry Mitzman, "The Problems of Minimalcy" The Math Learning Center, 315 13th St. N.E., Room 302, Salem, Oregon, 97301. Undated but contains a reference to a September, 1977 publication.)
7. Organization for instruction. Should the Middle school mathematics program be in a self-contained classroom or in a separate mathematics class taught by a mathematics specialist?
8. Grouping for instruction. The research on homogenous vs heterogenous grouping is equivocal with respect to student achievement. About the only thing that is clear is that teachers prefer homogeneous grouping, but few prefer to teach the lowest ability group(s). Should other arrangements be suggested such as grouping within a class or homogeneously grouping the top 10% and heterogeneously grouping the other 90% or encouraging independent study for the top 10-20% in a heterogeneously grouped class with the purpose of accelerating them to complete first-year algebra by the end of grade eight or...?

Needed Research

RECOMMENDATION 4. ($3,000,000)

Both basic and applied research related to the early adolescent's mathematical education should be encouraged and supported by NSF.

In some cases the problems stated above suggest problems for research. There are others listed below:

1. The nature of learning. We know all too little about how children learn mathematics. Brain mapping and its implications for teaching and learning are now being investigated. Right or left hemisphere dominance is getting increasing attention. Such basic research should be encouraged and supported. Other factors to be investigated are (a) the role of memorization in learning; (b) the place of physical materials to help children learn; (c) the emphasis needed on enactive, iconic, and symbolic activities for children of differing abilities; (d) the identification of learning styles of children; (e) the interaction of children's learning styles and different teaching styles.
2. Ways of knowing. What are the relative roles of experiences in enactive, iconic, and symbolic modes of learning activities? How does the need for experience in these three realms vary, if any, for children of different ability levels? different learning styles? different interests?
3. Imagination. What is the place of imagination in learning mathematics? Einstein once said, "Imagination is more important than knowledge. But knowledge is the fuel that fires the furnace of imagination."

4. Learning disabilities in mathematics. What learning disabilities interfere with the acquisition of the concepts and skills in mathematics? How can they be diagnosed and remediated?
There has been extensive research on learning disabilities related to reading, their diagnosis and remediation. Very little basic research has been done on learning disabilities related to mathematics. Few mathematics clinics exist; reading clinics abound.
5. The calculator. What effects does the use of the calculator have on (a) number fact skill development and retention; (b) development or retention of computational algorithms; (c) problem solving skills; (d) motivation; (e) attitudes toward mathematics?
6. Mental calculation. What is the role, of any, of mental calculation in learning algorithms for computation, particularly those using whole numbers?
7. The mathematics classrooms. What really goes on in America's mathematics classrooms? The NACOME report revealed that little is known about teaching strategies, materials used, and techniques of evaluation employed by classroom teachers.
8. Competency-based programs and minimum competency requirements for graduation. What effects are competency-based mathematics programs and minimum competency tests in mathematics for graduation having on school mathematics programs? on student attitudes? on parental attitudes? on teacher attitudes? (It may be too early to tell since many of these programs have just been initiated.)
9. Applications. What applications are suitable for the interests and abilities of the early adolescent? (E.g., mathematics and sports; banking and investments; operating a school store; simulating a grocery store in the classroom; recreations such as magic squares, puzzles, tricks and the like; informal geometry--perimeters, areas, volumes; roadmap reading;....) What, in the child's mind, is an application of mathematics?
10. Academic games. What is the role of academic games for teaching and learning mathematics?
11. Changing teachers. How can teachers be stimulated to change their teaching habits, techniques and attitudes? What are the characteristics of teachers who change? What factors in their educational or practical classroom experience or personality caused them to change? What are the characteristics of teachers who do not change?

APPENDIX C

Literature Review of Early Adolescence and Implications for Science Education Programming

Geneva D. Haertel

September 1978

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General Introduction

This document explores various issues relevant to the education of early adolescents. In Part I, characteristics of early adolescents of importance to their total educational program are presented. This section focuses on: (1) changes in cognition, (2) changes in social cognition, and (3) changes in significant social contexts. Part II of the document focuses on the learning context which is available to early adolescents. The sections in Part II include: (1) the challenges of early adolescence for the schools, (2) a description of the formal school setting, highlighting distinctions between the junior high and middle school organizations, (3) a status report on middle/junior high school teacher certification, (4) a description of staff support and other services available to middle/junior high school teachers, (5) current status of instructional practices for early adolescents in science, mathematics, and social science as well as instructional research in these areas, (6) information on group differences, including sex differences, relevant to science, mathematics, and social science education, (7) a discussion of the availability of curricula for early adolescents in science, mathematics, and social science instruction, together with several examples of curricula in these areas, (8) relevant information on career education for early adolescents with supporting research, and (9) a description of informal and adjunctive educational experiences for early adolescents.

Information collected for each of the sections was located in professional journals, government reports and, occasionally, through personal communications. Members of the National Science Foundation Panel on Early Adolescence provided the primary sources for the document. Their suggestions led to additional references which were used to construct the final document.

Three limitations on the scope of this document should be noted. First, it must be emphasized that this paper is not an exhaustive review of available literature. Rather, it touches upon basic concerns within a variety of topics, typically citing major sources, and summarizing relevant analyses and/or research. Second, the definition of early adolescence used in this document is the period spanning the ages of ten to fifteen. Third, there are few research findings or curricular efforts focused exclusively on the early adolescent as so defined. For this reason it was necessary at some points to include studies which involved older or younger children. Available educational and psychological literature on many aspects of this particular period of development proved to be meager.

PART I: THE EARLY ADOLESCENT LEARNER

THE EARLY ADOLESCENT LEARNER

Introduction

Early adolescence is defined for purposes of this report as that part of the life cycle which spans the ages of ten to fifteen years. Other definitions based on biological, psychological or cultural criteria could also have been chosen. This age range does not correspond specifically to any one stage in the major developmental theories or research to be reviewed, but it does correspond to the ages typically served by America's middle schools and junior high schools, and is therefore of policy relevance. From the point of view of psychological or sociological research, early adolescence so defined is not an arbitrary period. However, few studies in these areas address the period specifically. Lipsitz (1977) provides an extensive review of sources of research on this period, and concludes that there is a void in the research literature on children aged ten to fifteen. Likewise, Hill (1973) speculated that as few as five percent of the pages in the Journal of Developmental Psychology and Child Development had been devoted to research on adolescents during the past five years. Elkind (1975) also concurred on the paucity of early adolescent research. He stated in the opening of his article, "Recent Research in Cognitive Development in Adolescence" that there was a dearth of studies on adolescent thinking, a situation unchanged since it was noted by G. Stanley Hall in 1904. Because the early adolescent period does not coincide with any single stage in most developmental theories, it will often be necessary to discuss more than one stage of cognitive or socio-emotional development in order to characterize early adolescent thought and behavior.

It should be emphasized that early adolescence is seen as a segment of human development continuous with the earlier and later years (Konopka, 1973), not as an isolated stage. As will be described below, it is typically a period of significant physical, cognitive and emotional growth, and a period during which new patterns of acting and relating are forged, but it is not an "abnormal" period. The great majority of youths handle these changes well, and enter into middle and late adolescence and adulthood as successful, healthy individuals (Hill et al, 1976). Early adolescents are viewed in this document not solely as persons in preparation for adulthood, but as individuals engaging in the roles, acquiring the skills, and fulfilling the responsibilities appropriate to a particular time in life.

The nature of these roles, skill acquisitions, and responsibilities are suggested by Havighurst's (1951) description of the developmental tasks of adolescence, which he defined as the period from age twelve to eighteen.

Konopka (1973) presents a more recent list of characteristics of adolescence. She recognizes adolescents as growing, developing persons within a particular age category. They are not viewed as pre-adults, pre-parents or pre-workers, but as persons participating in society, important in their own right.

Konopka lists five concepts which characterize early and middle adolescence, which she defines as the period from twelve to eighteen. From Konopka's list, those concepts which seem to be most associated with early adolescence are presented below:

- Experience of physical and sexual maturity.
- Consciousness of self in interaction.
- Re-evaluation of values.
- Experimentation in wider circles of life coupled with insecurity and audacity.

- Movement from dependence on adults to interdependence with adults, peers and younger children. This movement produces a sense of loneliness and psychological vulnerability and may contribute to mood swings, argumentation and emotionalism.

This section is organized as follows. First, a sub-section briefly describing the context of the early adolescent in the contemporary United States appears. The following four sub-sections offer profiles of some salient characteristics of this period. These sections present characterizations of early adolescent thought, emotion, and behavior, drawn from a variety of theoretical models, together with related research. Because these models have been developed at different times and for different purposes, utilize different kinds of data and distinct methodologies, no cohesive synthesis is possible. However, the models and research taken together do offer a fairly clear profile of the early adolescent and the ways he or she is changing. The first of these four sections briefly describes physiological changes during early adolescence. The second presents material on cognitive development. The third and fourth discuss the development of social cognition and the influence of important interpersonal contexts for this period.

The Early Adolescent in the Contemporary United States

The Context of Early Adolescence

Table 1 provides recent data on population size and actual school enrollments of early adolescents. These figures indicate that there were 23.81 million early adolescents in the United States in October of 1976, the great majority of whom were enrolled in school, in grades five through ten.

Of the many social forces and conditions which impinge upon individuals in the United States, several merit special attention as determinants of the quality of the context of early adolescence. Factors which may be changing are of special concern, since changes may place new burdens upon adolescents and the institutions which serve them. In a Rand Corporation policy study of youth, Timpane et al (1976) identified some of these factors. While some of the changes described below may be transient historical fluctuations, others may signal enduring secular trends to which the institutions of the future will have to spread. Apparent trends, particularly relevant to early adolescence are as follows:

Timing of puberty. As will be noted in the next section, physical maturation occurs at an earlier age than in the past. This trend may be contributing to an increasing disparity among the ages of physical, cognitive and socio-emotional maturation. If cognitive and socio-emotional maturation are also occurring earlier, then perhaps consideration should be given to lowering the age at which the various responsibilities of adulthood may be assumed.

Increasing numbers of alternative options in occupation, education, and marriage. Greater latitude in choices of lifestyle increase the importance of opportunities for exploration and development of decision-making skills.

Rapid social change which erodes the relevance of some parental information. As new sexual mores, access to contraceptives and abortion, and new opportunities for women emerge, contemporary adolescents have more freedom in making major life decisions. The problems of maintaining parental roles as sources of information and authority, or of supplementing or supplanting some parental functions through other institutions, merit careful consideration.

Labor market conditions. Opportunities for full-time employment for youth have diminished since the past century, because of legal barriers and increasing skill requirements, among other factors. Underemployment and unemployment of youth may be expected to persist as serious problems (Coleman, 1974). While affecting older youth more directly, this reality places stress on young adolescents anticipating entering the labor market.

Affluence. Increases in real income permit middle class parents to purchase longer preparation periods for their children, reducing the pressure on adolescents to leave home or to find work, and increasing opportunities for investment in further education.

Family patterns and maternal employment. To these putative trends of Timpane and others should be added a possible trend toward increasing divergence from the pattern of the traditional nuclear family organization, and increasing participation of women with children in the labor force. While these changes may accelerate in the future, Hill and others (1976, p.246) have concluded: "The extent of actual change in the family circumstances in which adolescents are reared, of pluralism in family forms, and the rate of that change has probably been much exaggerated. Whatever its forms, the family continues to be an important and conservative social institution." The authors indicate also that research has indicated no differences in the social behavior of children whose mothers are at home versus those whose mothers work, but that research in this area had not focused on the early adolescent period.

Cultural pluralism. An enduring characteristic of American society is cultural pluralism. The needs and concerns of different racial/ethnic, religious, regional, urban/suburban/rural, and socioeconomic groups are different, and reflect distinct views as to what constitutes the "good life" (Konopka, 1973). Two possible trends of relevance in this connection are increasing urbanization and increases in the proportions of minority groups in the population.

Conclusion. The foregoing discussion is intended only to suggest some of the issues which must be taken into account in the formulation of policy for early adolescent education. Changes that are occurring within the youth themselves are also critical to the definition and servicing of the educational needs of this population.

Physiological Changes During Early Adolescence

The years from age ten to fifteen encompass a period of marked growth and development during which a rapidly changing youth can observe his or her own physical development. Changes include general growth, changes in shape, and emergence of secondary sex characteristics. Tanner (1962) stresses the great diversity in the physical and physiological status of children of the same chronological age during early adolescence. Males lag roughly two years behind females in physical development during this period.

Earlier physical and sexual maturation is a long-term trend which has been well documented; the age of menarch advances roughly four months per decade. Better nutrition is probably a factor in causing this trend. It should be noted that this trend cannot continue indefinitely. Lipsitz (1977) states that at least one study has found evidence that it has already ended.

In a classic longitudinal study, Jones and Bayley (1950) found an average difference between early and late maturing fifteen year old boys of eight inches and thirty pounds. They exhibited differences in strength, motor performance, coordination, reaction time, attractiveness as judged by peers, leadership role-taking, self-concept and other aspects of social behavior.

Table 1

Enrollment Status of Ten to Fifteen Year Olds by Race: October 1976

Age	Race	Population (in thousands)	Percent at Different Grade Levels*								
			Below Grade 5	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Above Grade 10	Not Enrolled
10	Total	3587	18.4	72.1	8.5	0.1	-	-	-	-	1.1
	White	2972	17.7	73.8	7.8	0.1	-	-	-	-	.9
	Black	558	23.8	62.7	12.5	0.2	-	-	-	-	.5
11	Total	3839	1.8	17.5	70.1	9.2	.2	-	-	-	1.1
	White	3211	1.6	16.4	72.1	8.7	.2	.1	-	-	1.0
	Black	564	2.8	24.3	59.0	11.7	-	-	-	-	2.1
12	Total	3909	.4	2.3	17.6	70.5	8.1	.3	-	-	.8
	White	3267	.5	2.0	16.5	72.0	8.1	.3	-	-	.8
	Black	569	.5	3.5	23.6	63.1	8.0	.5	-	-	1.1
13	Total	4076	-	.3	1.8	17.7	71.9	7.5	.2	-	.6
	White	3443	-	.2	1.6	17.5	72.7	7.2	.2	-	.5
	Black	551	-	.5	2.2	20.0	67.0	8.5	.5	.2	.2
14	Total	4152	-	-	.2	2.4	16.5	70.3	8.6	.5	1.5
	White	3477	-	-	.2	2.2	15.3	71.8	8.4	.2	1.6
	Black	604	.3	.2	-	3.6	23.7	61.4	8.9	.7	.8
15	Total	4247	-	-	.2	.4	2.8	19.8	65.1	9.6	2.1
	White	3605	-	-	.1	.2	2.3	19.0	67.3	8.8	2.2
	Black	574	.3	.2	.5	1.4	5.6	23.9	53.1	13.8	1.2

*Percents may not add to 100 in all rows, due to rounding.

Source: U.S. Bureau of the Census, Current Population Reports, Series P-20, No. 319, "School Enrollment-Social and Economic Characteristics of Students: October 1976," U.S. Government Printing Office, Washington, D.C., 1978.

Cognition and Learning in Early Adolescence

In this section research is presented bearing upon changes in cognitive processes during early adolescence. Significant research has accumulated which indicates that the cognitive abilities available to an individual are different at distinct points in the life cycle. Examples of a few cognitive abilities, which appear to develop over the course of childhood and adolescence, are the ability to represent, or model, sensory impressions in a coherent picture of the world, the ability to classify objects and form concepts, the ability to memorize, abilities involved in attacking problems, and reasoning abilities. One comprehensive theory of cognitive development which treats several of these abilities was developed by Piaget. Relevant parts of his theory are summarized in the first sub-section below. In the second sub-section, research is presented on selected cognitive processes which evidence change during early adolescence. The topics included in this brief review are: representation, classification and concept attainment, memorization, formulation of problem-solving strategies, and reasoning. These topics do not exhaust the set of cognitive processes which have been studied. Rather, they were chosen on the basis of their relevance to early adolescent education in science, mathematics and social science. The final subsection deals with "Cognitive Styles", which represent preferred strategies of information processing, and their relevance to schooling.

Piaget's Concrete and Formal Operational Stages

By the onset of early adolescence, virtually all children have attained what Piaget terms the concrete operational stage. At this stage, children have acquired conservation, and can apply basic logical operations in manipulating objects. They are able to nest classes and to seriate objects according to size or other attributes. Problems requiring the simultaneous consideration of more than two classes or dimensions are likely to give difficulty, and capacity for abstract thought is limited (Flavell, 1963). Development beyond this stage proceeds to the formal operational level, Piaget's final stage. In advanced societies, this stage may be reached between the ages of eleven and fifteen (Neimark, 1975). Formal operations represents the capacity to deal with abstract propositions and hypotheses. The ability emerges to consider systematically alternatives to the given reality, and individuals at the formal level are able to reflect critically upon their own thinking (Inhelder and Piaget, 1958). The proportion of individuals who reach this stage is subject to debate (Elkind, 1975), but there is substantial evidence that attainment of the formal operational level is by no means universal, even in populations past the age of early adolescence (Dulit, 1972; Neimark, 1975).

The following studies give evidence of some specific formal abilities which may emerge during the early adolescent period. All of these studies were based on Piaget's theory. Lovell (1961) and Jackson (1965) have demonstrated the emergence of formal operations around the age of eleven to twelve on a wide variety of tasks. They also found support for continued improvement through late adolescence. Lunzer and Pumfrey (1966) and Pumfrey (1968) found that proportionality, the skill of equating two ratios, did not often appear before the age of fourteen. Karplus, Karplus, Formisano and Paulsen (1975) found that less than one fourth of thirteen and fifteen year olds used formal operations on "proportional reasoning" and "controlling variable" problems. Linn and Levine (1976) found that formal operations were not used by all early adolescents in solving logical problems of the "controlling variables" type, but familiarity with the variables used influenced success rates.

These results indicate that some formal operational abilities are emerging during the early adolescent period, but abilities such as "controlling variables" (the strategy of holding other things constant in exploring the effect of one variable on an outcome) may be atypical among early adolescents. The results of Karplus and others (1975) suggest that performance on some of the experimental tasks used in this research may be influenced by instruction, but further research is required to establish the degree of teachability of these skills at the early adolescent level.

Research on Cognition and Learning

The following five sub-sections highlight research which points to changes in selected cognitive processes during early adolescence. Research stimulated by Piagetian theory is included in some of these brief reviews, but other studies not based on Piaget's theory are also included. As stated earlier, these five sections do not cover all the areas of research in cognitive development, but all five are areas in which changes of importance to schooling may occur during the early adolescent period.

Representation. Bruner (1966) discusses the problem of representation, i.e. the translation of experience into a model of the world. It is through such modeling that a child is able to conserve past experience and gain autonomy from the dominance of immediately present stimuli. The three modes of representation are thought to emerge sequentially, but by the onset of early adolescence all should be available to the child. These three modes are the enactive, or representation through activity itself, the iconic, in which visual or other perceptual images are used to represent information, and the symbolic, in which symbols, primarily in language, are used to encode information. The generative nature of symbol systems gives language and mathematics great power as instruments of thought. The principal modality developed during early adolescence would be the symbolic mode, but all three representational modes are available.

Classification and Concept Attainment. There is evidence for a shift to a different type of abstraction beginning in early adolescence. Classification by perceptual properties is replaced by categorical classification (Bruner, Oliver and Greenfield, 1966; Reichard, Schneider and Rapaport, 1944). In early adolescence there is also evidence of greater flexibility in making conceptual shifts from one type of classification to another (Elkind, 1975).

Memorization. The increase in immediate memory span with increasing age has long been recognized. Flavell (1970) summarized research showing that the following skills also increased with increasing age: awareness of the difference between perceiving and storing in memory, judgement of one's own capacity to remember, and use of more sophisticated mnemonic schemes. In addition, with increasing age there is an increasing tendency to store information in "chunks" rather than remembering and recalling a literal reproduction of the stimulus. Belmont and Butterfield (1969, 1971) found increasingly more abstract labeling as adolescence progresses.

Formulation of strategies for problem-solving. Neimark (1975) used a diagnostic problem-solving task to assess the onset of a formal operational approach to problems. Her research indicates that problem-solving strategies for early adolescents are more rule-bound than the strategies employed by younger children. A problem-solving strategy is "rule-bound" to the extent that it involves the systematic application of principles to the problem situation.

Rohwer (1973) has investigated the training of children to use strategies in paired associate learning tasks. He is particularly interested in early

adolescents who do not spontaneously produce strategies when trying to solve a problem. Rohwer identifies the period from eleven to fifteen years as the time when the "minimal prompt shift" to spontaneous strategy production typically occurs. Many low-income students at this age level do not demonstrate this ability to form a strategy from cues presented in the context of the problem, but Rohwer's studies indicate that on simple tasks such as paired associate learning, they can learn the necessary problem-solving orientation. Whether these strategies can be transferred to more complex forms of problem-solving remains to be seen.

Reasoning. Neimark (1975) reviews literature on logical reasoning and concludes that most abstract logical reasoning abilities do not begin to emerge until early adolescence. For young children, the ability to reason logically is situation-specific. They may learn to apply logical processes in an isolated context, but consistent performance using a variety of materials is not seen. Even in early adolescence, the emergence of abstract logical reasoning abilities is by no means universal. For example, transitive inference (Hunter, 1975; Piaget, 1964) and sentential logic (Mitta and Nagano, 1966; Neimark, 1970) do not begin to appear before the age of fourteen or fifteen.

For purposes of science, mathematics, and social science education, the critical questions are 1) Are there distinct logical and reasoning skills required to master scientific material? 2) If so, what are these skills? 3) At what age are children capable of utilizing these skills? and 4) Can these skills be taught? Several investigators have examined processes that may be central to scientific comprehension and problem-solving, and have investigated the possibility of teaching these skills. Typically, children aged thirteen or older were used in these studies. Thus, results may be more applicable to the latter part of the early adolescent period than to the ten to twelve year old age range. Levine and Linn (1977) studied "scientific reasoning," or the ability to control all but one manipulated variable when investigating its effect. They review research suggesting that 1) this ability may not be highly related to the combinatorial system central to formal operations (Ennis, 1975), 2) this ability may be teachable (Beard, 1962), 3) demonstration of the ability is influenced by organization of the problem (Linn and Levine, 1976), and 4) demonstration of the ability may be impeded by the presence of irrelevent information (Linn and Levine, 1976; Karplus, Karplus and Wollman, 1974). The conclusion reached by Levine and Linn (1977) was that only a small number of early adolescents can effectively control variables, but the ability can be taught. Linn (1977) discusses, in addition to controlling variables, the use of apparatus to set up appropriate experiments, elimination of irrelevent information, and careful observation of experimental results in connection with four typical Piagetian experimental tasks. She relates differences between results of different researchers to differences in performance criteria and the use of probing questions, and suggests instructional applications.

Formal logical reasoning may be critical to typical early adolescent science, mathematics, and social science instruction, but it has been hypothesized that "everyday reasoning" differs from formal reasoning in important respects (Braine, 1978). The logical reasoning abilities that help to define Piaget's formal operations are used by an individual to determine what necessarily follows from a given set of premises. Braine (1978) distinguishes these operations, which correspond to formal logic, from the operations of practical, everyday reasoning. In the latter, all the information at a person's disposal, not just the information contained in the explicit premises, may be used. The deductive steps involved are posited to be similar for the two kinds of reasoning, but formal reasoning requires an attention to the explicit content of the premises, and an exclusion of other available information, which is foreign to the ordinary

conversational use of language. In addition, natural language does not require attention to the distinction between truth and validity which is required in formal logic.

It may be that early adolescents who are not at the formal operational level nonetheless have and use a natural logical reasoning system. Braine cites research by Bucci (in press) in which the performance of some elven and twelve year olds suggested that they did not possess strategies for determining exactly what information is explicitly provided by sentences. Thus, poor performance of children at this age on tasks requiring formal operations might reflect only their inability to follow the convention that they must use only information explicitly provided. It would not follow that they did not possess the logical schemata required.

While there is some scattered empirical support for Braine's position, much remains to be researched. Its importance to developmental theory for early adolescence may be in clarifying what logical capacities most youth possess at this age level, and how these relate to the demands of Piagetian formal operational tasks. Braine asserts that, "regarded purely as logical systems, natural and standard propositional logic are the same system on different foundations" (page 18). If this is the case, it may be that the psychological acquisitions that mark the transition from the concrete to the formal operational level are not logical schemata per se, but rather ancillary skills in the interpretation and application of these schemata in a rigorous manner, limiting the premises to what is given and distinguishing truth-value from correspondence with reality. If there is a "natural logic" that early adolescents can use, it might be possible to exploit this logic in the teaching of science, mathematics, and social science without demanding formal operations as conceived by Piaget.

Investigations in other areas of reasoning are also relevant to instruction at the early adolescent level. For example, Tversky and Kahneman (1971) describe experiments showing that adults tend to regard samples as overly representative of the populations from which they are drawn. The existence and significance of logical errors and biases of this kind in early adolescents should be investigated, because they impinge upon the validity of reasoning in natural settings and especially upon the application of scientific methods. If such errors are found to characterize the early adolescents' thought, then instruction may have to take into consideration these tendencies.

Cognitive Style

The term cognitive style refers to a preferred strategy of information processing (Cronbach and Snow, 1977). Early work in this area tended to define stylistic variables in terms of sensory and perceptual processes, and problem-solving approaches. More recently, there has been work in the area of mnemonics and logical reasoning. Three different types of cognitive style on which a number of studies have been done are: Hunt's conceptual level (Hunt and Sullivan, 1974), Witkin's (1973) field independence, and Kagan's reflection-impulsivity dimension (Kagan, Moss and Siegel, 1963). Researchers have succeeded in differentiating children whose cognitive styles differed along these various dimensions. Baumrind (1978) states that a growing literature documents differences in stylistic variables between males and females, and among different cultural groups (Kagen and Carlson, 1975; Ramirez and Castaneda, 1974; Waber, 1977).

If such differences are to be utilized in the improvement of instruction for early adolescents, it must be demonstrated that different instructional treatments are superior for different groups of learners. That is to say, the classification of early adolescents as to cognitive style is of no benefit to classroom

practice unless it is shown that different groups are best treated in different ways. This observation has led to the paradigm of the aptitude-treatment interaction (ATI), in which an interaction is sought between some variable characterizing pupils, e.g. cognitive style, and response to some set of two or more instructional treatments.

In a recently published book that reviews research on ATI, Cronbach and Snow (1977) state that there is little systematic evidence for interactions of cognitive styles and distinct instructional approaches. In their review of the work on Hunt's conceptual level, eight studies are presented, one of which dealt with early adolescents (Hunt et al, 1974). Marginal evidence was obtained for a weak ATI of cognitive level with teaching style. Of eight studies reviewed by Cronbach and Snow that employed Witken's construct of field dependence versus field independence or Kagan's reflective-impulsive dimension, three used pupils at the early adolescent level. One of these three showed no evidence of ATI (Rennels, 1970), one showed a complex pattern of many significant results which was difficult to interpret (Grippen, 1973), and one showed weak evidence for an ATI among boys only (Grieve and Davis, 1971). While these results are not strong, some possible ATI involving more recently developed stylistic variables based on mnemonics or logical reasoning have yet to be investigated, especially for early adolescents, and may provide a basis for differential instruction. Research on these variables is most likely to prove fruitful if clearly distinct, carefully implemented instructional treatments are employed, and careful attention is given to the suitability of outcome measures for students exposed to all treatments.

Implications

- Middle/junior high school teachers need to be made aware of the diversity in cognitive abilities characteristic of early adolescents. A significant amount of information has been collected on these differences. This information is especially critical to science, mathematics, and social science teachers whose subject matter requires logical and reasoning skills.

- Some, though by no means all, early adolescents have attained the formal operational level. Science, mathematics, and social science curricula should reflect the patterns of abilities among early adolescent learners.

- Further study of the relationship of cognitive style and instructional practices may reveal interactions important to science, mathematics, and social science schooling.

Social Cognition in Early Adolescence

In the previous section of this review, the cognitive characteristics of early adolescents were described. The growth of cognitive competencies may be accompanied by significant changes in social cognition. This section deals with the way early adolescents process information about social dimensions of the world in which they live. It points up the importance of early adolescence as a period during which significant changes in social cognition may occur.

Hill and Palmquist (1978) review a number of studies in this area. Their conclusions suggest marked changes during early adolescence in the way impressions of the self and others are formulated. Impression formation during early adolescence is characterized by greater abstraction than in earlier periods. There is an increased ability to evaluate persons apart from extrinsic characteristics such as physical appearance or possessions, and apart from recent events, and an increase in the attribution of attitudes, motives, and personality traits. Evaluations of others, and self perceptions as well, show greater differentiation, i.e. more categories of personal characteristics are distinguished, and applied in forming impressions of the self and others.

Many investigators have reported increases beginning in early adolescence in sensitivity to non-verbal forms of communication, and in the ability to interpret feelings and to infer thoughts, intentions, motives, or causes. There is an increase in the ability to think about another's actions and attributes as independent from one's own thoughts during this period. As these changes occur, the early adolescent begins to develop "implicit personality theories" (Barenboim, 1978b) in organizing perceptions of people.

This review of social cognition in early adolescence begins with three sections in which important theories and significant studies are reviewed. The first of these, on impressions of the self and others, includes studies on inferences about thought, organization of social perceptions, and identity formation. This first sub-section is largely concerned with perceptions of the self and of other individual persons. In the second sub-section, on role-taking, theories are summarized which offer perspectives on the early adolescent's view of a broader social context. The contrasting views of Selman (1971, 1976a, 1976b) and Elkind (1967) concerning early adolescents' perspectives on their individual roles in society are presented. The third sub-section, on moral development, social convention, and political conceptualization, presents theories which may illuminate early adolescents' valuations of persons in society and of societal norms.

Following these three sub-sections, possible relations between the social and cognitive domains are briefly described, and implications are drawn.

Impressions of the Self and Others

Early adolescence is a period marked by significant changes in the way impressions are formed of the self and others.

Inference about thought. An important area of research in impression formation concerns the adolescent's increasing ability to engage in "recursive thought", i.e. to think about others' thoughts, especially others' thoughts about abstractions. One particular study of interest was conducted by Barenboim (1978a). This study examined the production of recursive and concrete inferences in twelve to sixteen year olds. A shift was documented from the production of inferences about thoughts whose objects are concrete to the concurrent production of concrete and recursive thought. Hill (1977) summarizes the Barenboim study as follows:

> There was a major shift between twelve through fourteen year olds in the proportion of subjects who made spontaneous inferences of recursive thought when asked to describe three persons well known to them (but not family members). Inferences that the other thought about concrete objects and actions did not increase significantly after age twelve while inferences that the other thought about thought increased significantly only after age fourteen. There is then a shift from the virtually exclusive production of inferences about thought whose objects are concrete to the conjoint production of concrete and recursive inferences in fourteen and sixteen year olds (p.7).

It appears that early adolescence is a period when individuals begin to produce and use highly differentiated, abstract inferences and constructs when describing self and others.

Organization of social perceptions. As some early adolescents begin to move from the concrete to the formal operational level, products of the earlier period are organized and integrated to produce new abstractions. In the area of person perception, this results in sets of contingent relations among psychological constructs. As Barenboim (1978b) states, "implicit personality theories" are developed. Evidences of organizing are found in the use of quasi-causal explanations, qualifying statements, metaphors, analogies, distinctions between real and apparent qualities, distinctions between the past and the present and the actual and the possible, tendencies to organize positive and negative impressions into a meaningful whole. Several researchers in this area of "organizing thought" have found evidence that the use of certain kinds of organizing statements increases with age, and some of the data suggest that such statements first occur around puberty or beyond.

Identity Formation

Another theoretical approach to social cognition is found in the work of Erikson (1959). Erikson describes eight stages in the socialization process. Each stage involves a "psycho-social crisis" that must be resolved before the next stage can be attained. The Erikson stages describe successive differentiations in self-esteem (Kohlberg and Gilligan. 1972). Two stages which seem to apply to the early adolescent period are "industry versus inferiority" and "learning identity versus identity diffusion." The first, "industry versus inferiority", Erikson believes is handled during the school years through the early junior high years. It is characterized by youth learning to relate to peers according to rule structures; moving from free, unstructured play toward formally structured play; and mastering of school content with a necessary increase in self-discipline. The "learning identity versus identity diffusion" stage is believed to occur between ages thirteen or fourteen and twenty-five. Erikson (1968) states that the resolution of the identity crisis requires many processes including: high differentiated views of self and others, reflective thought, coordinating impressions of self and others, as well as role-taking. All of these processes become available, in part, during early adolescence and may require formal operations. Hill and Palmquist (1978) indicate that, unfortunately, there are no studies at the junior high school level of the relationship between identity formation and social cognition. Hill (1973) and Offer (1969) question whether a "full blown identity crisis" is universal among adolescents. Increasingly, researchers such as Baumrind (1975) are recognizing alternate paths in

socialization that circumvent any such crisis.

Role-taking

Another area of social cognition that merits consideration when dealing with early adolescence is role-taking. Role-taking is often seen as the ability to understand that someone else has an individual perspective and to have some information about that perspective. Hill and Palmquist (1978) cite the Shantz (1975) review of role-taking which includes pertinent research under a variety of labels including: egocentrism; referential communication skills; perceptual, cognitive, and affective perspective-taking; and empathy. This research points to early adolescence as the time when youth learn spontaneously and consistently to take the role of the other during social discourse.

Emergence of a societal perspective. The development of a societal perspective, or coordinating of all possible third person perspectives, has not been well researched at the early adolescent level (Hill and Palmquist, 1978). However, one recent theory of social perspective-taking was developed by Selman (1971, 1976a, 1976b; Selman and Byrne, 1974). Selman claims that social perspective-taking follows an invariant stage sequence. The preadolescent, in this theory, is capable of complex recursive thinking and can identify the point of view of each individual in a dyad from that of a third individual. During early adolescence, Selman hypothesizes, youth move to a higher stage where they have a societal perspective which permits them to compare and contrast sets of perspectives of self, other, and generalized other. At this stage youth recognize the shared perspective among individuals that exists in any social system (the generalized other) and how this aids in communicating and understanding others. It should be noted that ability to recognize the shared perspective is not the same as actually behaving in a way which reflects this understanding. Hill and Palmquist (1978) indicate that Selman's theory has not yet been carefully examined with regard to hypotheses about early adolescent behavior.

Early adolescent egocentrism. Another theoretical point of view on role-taking is presented by Elkind (1967). For Elkind, egocentrism in early adolescence is reflected in a belief by adolescents that others are as preoccupied with their appearance and behavior as themselves. This belief, which accompanies the onset of formal operations, stems from adolescents' inability to differentiate their own concerns from those of others, and results in overconcern and conflict. The overconcern results from the mental construction of an "imaginary audience" which is believed to be either critical or admiring of the adolescent. Adolescents also become overconcerned with their own feelings, which Elkind suggests may come from believing they are of such great importance to their imaginary audiences. The result of this preoccupation is the construction of a "personal fable". In other words, adolescents are self-conscious (the imaginary audience) and have profound feelings of uniqueness (the personal fable). This egocentrism is overcome by the gradual differentiation between their own preoccupations and other people's thoughts, and the integration of other people's feelings with their own to reduce their sense of uniqueness. It is hypothesized that formal operations eventually provides adolescents with the ability to recognize how private their own thoughts are and at the same time increases their sense of social isolation. Elkind's propositions have not been empirically tested (Hill and Palmquist, 1978). The theories of Elkind and Selman describe the role of formal operations very differently and implications are contradictory. Whereas for Selman the attainment of formal operations leads directly to a more differentiated and decentrated societal perspective, Elking hypothesizes that the onset of formal operations is accompanied by an egocentrism stemming from a kind of

conceptual confusion.

Moral Development, Social Convention, and Political Conceptualization

A substantial amount of the literature on social cognition deals with moral judgement and the work of Kohlberg.

Moral development. Kohlberg (1963) has described three levels of moral judgement: the pre-conventional level, the conventional level, and the post-conventional level. Each of these levels contains two stages of moral development. Development of the individual proceeds in an invariant order through these six stages, although not all individuals reach the highest stages. In order to move from one stage to the next, there must be a conflict which drives individuals to abandon their prior reasoning for a new cognitive structure. In the early adolescent period, the most likely conflict, or source of growth, is identified as cultural relativism. Kohlberg and Gilligan (1972) link cultural relativism to a transition from conventional to principled morality. For adolescents, this transition may typically be associated with an identity crisis. Kohlberg and Gilligan briefly discuss curricular implications for educating early adolescents, basing their recommendations on actively drawing out principled logical and moral thought, rather than presupposing it. It should be recognized that Kohlberg's work has been criticized from a variety of perspectives, suggesting that his definitions of stages and underlying assumptions are culturally biased and his findings are methodologically unsound (Simpson, 1974). Kohlberg's (1963) original work suggested that most adolescents would acquire principled moral judgements, but later work (Kohlberg, 1973) made this issue more questionable. Holstein (1976), on the basis of longitudinal data, doubts that levels five and six are part of the developmental sequence. Rather, it appears that conventional rather than principled morality may be the dominant morality of adolescence.

Social convention. Turiel has separated the study of social convention from that of moral judgement (Hill and Palmquist, 1978). Turiel defines social conventions as arbitrary uniformities that coordinate social discourse within a social system. Turiel's proposed stages are age-related and invariant. The invariance of these stages has not yet been empirically confirmed, although a longitudinal data collection is ongoing. Hill and Palmquist (1978) describe Turiel's stages which are relevant to early adolescence, in the following quotation:

> According to Turiel's formulation, between six and eleven, convention comes to be seen as arbitrary and changeable. Adherence to convention is based on concrete rules and authoritative expectations. Around twelve to thirteen, conventions come to be seen as arbitrary and changeable, regardless of rule. Conventions are 'nothing but' social expectation. At fourteen to sixteen, systematic concepts of social structure emerge for the first time and conventions are seen as the form of normative regulation in a unified, fixed, and static hierarchical organization (pp.15-16).

Early adolescence is identified as the period during which individuals begin to recognize the role of social conventions as coordinating social interaction.

Political conceptualization. Within the research on social cognition, Adelson's (1975) work on political thought has drawn significant attention. In a study of early adolescents in three countries, Adelson found that between the ages of eleven and fifteen thinking about the law and society changes dramatically.

During this period youth first come to understand the abstraction "law", then develop a historical perspective and an awareness of historical causality, come to understand the mutability of social conventions, and, finally, acquire the concept of the common good. These changes have significant corollaries in the intellectual and social realms. As adolescents develop a framework in which to view human behavior, they begin to develop for themselves a set of principles. Lipsitz (1977) cites a study by Gallatin, Adelson, O'Neil and Miller (1972) that provides direct information on early adolescence. In their study of political ideation in black and white students in grades six, eight, ten, and twelve, changes like those described by Adelson were found for both racial groups. With increasing age, youth grew more humanitarian and democratic, and less punitive in their stance toward crime. Few differences appeared between racial groups in terms of political ideation, indicating that effects of the differential socialization of the two groups were relatively minor, although there were differences in terms of specific attitudes. The importance of this work is in its curricular implications. There are, despite differences in developmental rates, certain age-specific capacities which can be planned for so that schools do not teach political concepts, e.g. taxation, to youth who are too young to understand the social abstractions underpinning them.

Relations Between the Social and Cognitive Domains

For Piaget the role of social relations is primary in the transition from one stage to another. Hill and Palmquist (1978) bring a number of studies to bear on this issue. They find that there is some support for a positive relation between social interaction and cognitive change. Less support was found for Kohlberg's hypothesized positive and linear relationship between role-playing opportunities with peers and adults and social perspective-taking. The authors review two studies suggesting that there may be a threshold effect, such that a certain amount of social experience is required in order to develop a social perspective, but additional experience beyond this amount does not produce differential skills (West, 1974; Hollas and Cowan, 1973). Hill and Palmquist (1978) cite the observation of Kurdek (1977) that findings on the relationship among perspective-taking, moral development, and prosocial behavior are inconsistent. Furthermore, only one of the studies involved a sample of youth past the age of twelve, hence little can be inferred about the relationship between the social and cognitive domains beyond this age level.

Implications

- Educators at the middle/junior high school level must recognize the diversity among early adolescents in psycho-social development, and the preemptive nature of social and other concerns during this period.
- Research should be fostered on the relationship of early adolescents' social perception and schooling. For example, the effect of science, mathematics and social science teachers as role models who apply rational, scientific thinking in solving problems might be researched.
- Developers of curricula in science, mathematics, and social science, at this age level, should bear in mind the need for highly motivating materials and activities when structuring such curricula. Motivation must be taken into account, especially in designing curricula for early adolescents.

Social Context of Early Adolescence

Two major contextual factors in early adolescence are the adolescent's parents and peers. For purposes of this review, peer and parenting influences are treated separately in the following two sections. This is not to imply that the two influences are independent. The interaction between parent and peer values and the tension of conflicting expectations from these two sources may be significant conditions of early adolescence. While an attempt has been made to include only research focused directly on the early adolescent, it was necessary to include some studies of peer and parental influence among high school students. This was because little research has been conducted in some of the areas to be reviewed at the early adolescent level.

Peer Influences in Early Adolescence

A variety of researchers have recognized the peer group as a socializing agent. The importance of peer group is shown by Coleman's (1961) finding that high school students are nearly equally divided as to which would be more difficult for them, disappointing a parent or breaking off a friendship. In addition, Bowerman and Kinch (1959), in an investigation of family and peer orientation comparing fourth and tenth grade students, documented that as students got older there was a trend away from a family orientation and toward the peer group. A study in Great Britain comparing parent and peer influence (Musgrove, 1964) showed that older children were more likely to identify friends rather than parents as preferred companions. These studies suggest that while the family remains a significant influence, in the course of early adolescence the peer group becomes increasingly significant as a socializing context. Epperson (1964) conducted research on some of the same issues as Coleman (1961) had investigated, and concluded that, while peer loyalties were strong, adolescents have multiple allegiances, and loyalty to parents remains very important. Acceptance by peers does not imply disapproval by parents. Bronfenbrenner (1972) cites an unpublished study by Condry and Siman showing that dependency on peers had increased over the preceding decade for children at all age and grade levels. According to Bronfenbrenner, more recent work by Siman indicates that dependency on peers rather than parents is greatest where one or both parents are frequently absent.

Given the importance of peer influences during this period, the values of the peer group with respect to academic achievement may be an important determinant of attitudes toward schooling. In a sociological study of ten high schools, Coleman (1961) found that in some schools the leading cliques did not esteem academic achievement, and peer influences tended to discourage academic striving. In other high schools, academic success was encouraged and respected by the peer group. While Coleman studied older adolescents, his findings suggest the potential significance of peer attitudes toward schooling during at least the latter part of early adolescence. It should be noted that Coleman's findings do not necessarily imply that parental influence on academic aspirations are unimportant, or even that they are less important than peer influences. It may be, for example, that early adolescents typically affiliate with peer groups reflecting their parents' values.

The question of what are the dominant values of the early adolescent subculture has also been extensively treated in the literature. One important early study which bears on this issue is the Peck and Havighurst (1960) longitudinal study of factors related to adolescent character development. This longitudinal study of children from ten to seventeen offers some insights into adolescent values. It was found that in judging and rewarding peers, the adolescents took

into account not only surface values (clothes, athletic ability) but also moral values. As students got older they weighted character values more heavily in relation to surface values. It is the case, however, that students did not place much value on scholastic achievement.

Gordon (1972) presents the problem of peer sanctions mitigating against adult societal values (e.g. academic achievement) in somewhat different terms. For Gordon (1972) acceptance versus achievement is the major dilemma faced by the early adolescent. Gordon defines acceptance as "symbolically validated membership and welcomed participation in a group's important interaction patterns." Achievement is defined as "symbolically validated performance against a socially defined standard of excellence or competition." There can be a conflict between acceptance and achievement in that some of the more obvious forms of achievement, such as making high grades in school, may reduce one's popularity with peers. However, there are other types of achievement that typically lead to increased popularity, e.g. achievement in sports or other extracurricular activities. Gordon states that the value priorities Coleman found may be different for the current generation of adolescents, but believes the achievement versus acceptance dilemma still persists.

In spite of evidence as to the importance of peer influences during early adolescence, several studies indicate that parental influences remain more important than peer influences (Campbell, 1969; Douvan and Adelson, 1966; Kandel and Lesser, 1969; Sewell and Shah, 1968). According to these studies, parental values remain the principal determinant of educational aspirations and occupational plans. One critical series of studies in this area was conducted by Brittain (1963, 1968, 1969), who found that the domains in which peers and parents influence adolescents are distinct, though overlapping. "Peer-compliant" areas of behavior, i.e. areas in which peer influences dominate, have to do with status and identity needs within the peer group. Status in the larger society is more "parent-compliant." In more recent work, Kandel and Lesser (1969) substantiated Brittain's hypothesis that in choice areas perceived as more difficult and important parental influences predominate.

Many significant areas of research on peer cultures have been omitted from this review. Much of this research, however, has focused on students of high school age, rather than early adolescents. The studies included were chosen to highlight the importance of both peer and parent influences upon the attitudes and values of early adolescents. A problem which should perhaps be researched is how to channel the attitudes and values of early adolescent peer subcultures in healthy, socially desirable ways. Parents and other strong adult role models should have significant influence in this area. When either parent is largely absent, so should adult-sponsored youth organizations. The Panel on Youth of the President's Science Advisory Committee (Coleman, 1974) notes that "many (such) organizations are now suffering from a confusion of purpose, having experienced a weakening of their original commitment to the value of crafts or nature study as ways to build character without having settled on a new set of goals" (pp.164-165).

Parenting Influences in Early Adolescence

Hill et al (1976) states that many parents are poorly equipped to deal with the biological, psychological, and social changes of the early adolescent period, which "virtually recreate the person" (p.247). Researchers have related patterns of adolescent behavior to the behavior of their parents, e.g. Bandura and Walters (1959) work on adolescent aggression. Another approach of researchers has been to

attempt to identify factors underlying different parenting styles (e.g. Sears, Maccoby and Levin, 1957). Lipsitz (1977) cites as "the best known work on parenting styles" that of Diana Baumrind. Baumrind's work has focused on the relation of distinct types of parental discipline to the development of instrumental competence, characterized by "social responsibility, independence, achievement orientation and vigor" (Baumrind, 1978). She describes the special significance of parental involvement during the role changes which begin in early adolescence. A series of changes is initiated, in the course of which "dependency upon parents is relinquished, childhood status given up, and a new set of normative reference groups, values, and behaviors is developed" (1978, p.259). Withdrawal of parental commitment during this critical time, Baumrind asserts, may push the early adolescent to rely more heavily upon the peer group for support. Baumrind (1975) has described eight prototypes of adolescents, developed by taking all possible combinations of high versus low social responsibility, activity, and individualism. Emergence of one or another of these eight prototypes of adolescents is related to different patterns of parental discipline, degree of warmth, and other aspects of parent-child interaction. Parallels appear in the characterizations of the parents of adolescents low in social responsibility, but the parent-child relationships posited to account for the four high social responsibility patterns are quite distinct. Several specific hypotheses are as follows: 1) A failure by parents to recognize adolescents' need for control may lead the adolescent to feel deserted and thus to turn to a deviant peer group for norms and reinforcement. 2) Effects of authority patterns differ for boys and girls. In particular, aggressive independence should be encouraged in girls if they are to develop requisite competencies. High parental demands and avoidance of overprotective behaviors are associated with this development of independence in girls. 3) Harsh, arbitrary, or exploitative parental behaviors will lead to antisocial aggressiveness by youth. In particular, middle class delinquency may result from inconsistent, exploitative or egocentric parental behavior.

A related function of parents of early adolescents is to serve as role models. Bronfenbrenner (1972) deplores the high degree of age segregation in our society, and points to the isolation of children from the world of work as one significant consequence. In an examination of the roots of alienation in American society, Bronfenbrenner deplores what he sees as a breakdown in the family. He concludes that "many parents have become powerless as forces in the lives of their children" (p.662). An important step to counteract these alienating forces would be to devise creative social innovations to reacquaint children with adults as participants in the world of work. Bronfenbrenner (1970) describes one such program widely employed in the Soviet Union wherein a special relationship is established between a group of workers and a group of children, not by way of vocational education, but rather to familiarize the children with the workers as people, their activities, and their roles as adults participating in the world of work.

Baumrind (1968), in examining the efficacy of adults as role models, states that power cannot and should not be used to legitimate authority. The adult must be willing to assert and defend rationally any directive given to an adolescent. This advice is not solely directed at parents, but rather at all adults, especially teachers with whom early adolescents and adolescents come in frequent contact. The question of the effectiveness of role models as a deterrent to classroom discipline problems has not been researched. Limited evidence concerning this issue comes from Bronfenbrenner's tours to other countries. He reported observing more direct cultivation of the presence of adult role models in the schools of some other nations.

Implications

- Early adolescence is a period during which peers begin to become a more significant source of values. Science, mathematics, and social science achievement may be more esteemed throughout this period, if it is fostered as a value of the peer culture. The furthering of such values in the context of adult-led youth clubs and organizations, as well as the context of youth-initiated activities, should be explored.

- Teachers would benefit from information on changes that occur during early adolescence in the significance of different social contexts (adults, parents, and peers) as sources of values. In particular, their significance as role models for scientific, rational thought should be researched.

- More opportunities might be provided for early adolescents to explore science, mathematics, and social science in a variety of settings that provide for interaction with individuals of different ages and ethnic backgrounds.

PART II: THE LEARNING CONTEXT

THE LEARNING CONTEXT

Introduction

Early adolescence is commonly acknowledged to be a period of great importance in psycho-social development. Kagan (1972) identifies a variety of "Preoccupying motives" for many early adolescents, including sexual inadequacy, interpersonal power, autonomy of belief and action, and acceptability to peers. He believes that resolving these issues is of utmost importance to the early adolescent, and dominates weaker interests to be competent in school. For this reason, psycho-social as well as cognitive factors must be taken into consideration in any complete treatment of early adolescent education.

The importance of early adolescence as a period of critical intervention is pointed out by Lipsitz (1977). She reviews a study conducted by Bachman (1972) who examined causes of dropping out of high school. To determine the distinctive attributes of dropouts, a variety of personality traits were examined. The conditions that are usually seen as effects of dropping out proved in general to be pre-existent, having their origins much earlier. Patterns leading to failure typically were already established by the beginning of tenth grade, pointing to the prior period of early adolescence as critical for intervention with high-risk children.

Various social indicators also point to the period of early adolescence as one which merits greater attention and concern. In her book, Growing Up Forgotten, Lipsitz presents tables of census data which document the problem of early adolescents institutionalized due to mental illness, juvenile delinquency, and parental neglect. Incidents of drug abuse, suicide, unplanned pregnancies, and running away during early adolescence, while not characteristic of most youths, are increasing among adolescents and in some cases peaking among fourteen and fifteen year olds. This information points up the need for intervention during this age span.

How responsive is our current educational system to the special needs of early adolescents? This question will be answered, in part, in the second half of this document which focuses on the learning context, formal, informal, and adjunctive, which surrounds early adolescents. In the section on the learning context, there is a description of the junior high school and the middle school with reference to their historical and philosophical foundations. Research conducted to compare these two institutions is reviewed. In addition, there is a brief examination of the current practices, teacher certification and preparation, facilities, and staff support available to these institutions within the areas of mathematics, science, and social science. Instructional research and examples of curricula are briefly discussed for each area. The concept of career education is presented in terms of its successful performance at this age level as well as the rationale guiding its infusion into current mathematics, science, and social science curricula. Finally, there is a discussion of informal and adjunctive education and their saliency for early adolescents.

Before turning to these detailed treatments, it is well to consider the general fit or lack of fit between formal instruction at the middle/junior high school level and the particular needs of early adolescents. In the first part of this paper, early adolescence was characterized as a period of growth and change, and of great variability among learners. The period brings rapid physical growth, the onset of puberty, the beginning of new cognitive abilities, participation in a broader social context, increasing importance of peer affiliations, and greater sensitivity to the political and ethical aspects of events. Moreover, these changes proceed at very different rates for different individuals.

Because of these changes, middle/junior high schools face a special challenge. The adolescent growth spurt challenges the schools to provide more opportunities for physical movement and "letting off steam." The onset of puberty brings needs for information, and for opportunities to develop a self-image through interactions with peers. Cognitive changes during this period equip some youth for more rigorous and abstract inquiry in mathematics and the sciences, and the schools are challenged to respond with suitable curricula. At the same time, other early adolescents will not have attained these abilities, and must be provided differential instruction. As social awareness increases, early adolescents may call upon the schools for the first time to provide experiences relevant to the world outside the school, including the world of work. Youth struggling to attain a personal identity may be especially needful of opportunities for commitment, and during this period some may be especially vulnerable to the dangers of overemphasizing competition and achievement.

In addition to the diversity of physiological, intellectual, and social needs of early adolescents, middle/junior high schools are challenged to respond to the diversity of a pluralistic society, in which students from different cultural groups may bring their own needs and expectations to the school setting.

In response to these needs, the schools are called upon to offer increased diversity in both curricula and instructional approaches. Meaningful, relevant learning experiences should be provided, including experiences in settings outside the school walls. The remainder of this document describes the context presently provided for early adolescent learners.

Formal Public School Instruction for Early Adolescents

Various administrative organizations are distinguished primarily by the range of ages and grade levels served in a single school. Students between the ages of ten and fifteen are enrolled in either a more traditional school organization where elementary school is followed by junior high school or they move into a middle school and remain until grade nine. Each of these two types of school organization will be described.

Junior High Schools: The Traditional Pattern

The junior high school has been the most typical kind of school serving the early adolescent. A variety of reasons for the development of junior high schools were set forth during the first few decades of their existence, including the requirements of the labor market for more adequately prepared laborers, as well as concern for the unique psychological and social needs of preadolescents. Hurd (1970) discussed these needs in detail, citing, for example, concern that junior high school students be isolated from the mores of high school students; keeping dropout-prone pupils until the end of ninth rather than the end of eighth grade; and reducing crowding in elementary school buildings. In the next section, a brief historical description is presented of junior high school science, mathematics, and social science curricula.

Science, mathematics, and social studies in the junior high. The science, mathematics, and social studies taught in junior high schools were either an extension of the elementary school curriculum, or "watered down" versions of high school curricula. These curricula were generally not focused on the special needs of early adolescent learners. By the mid 1950's, general science courses were well established in grades seven through nine, but little additional coursework was offered. A United States Office of Education (USOE) report cited by Hurd (1970) showed that as recently as 1963, grade seven, eight, and nine science was confined almost solely to general science courses, taken by about two-thirds of the students. These courses were almost always textbook based, with laboratory work not uncommon, but teacher demonstrations more typical. The courses were generally not designed to synthesize elementary school experiences, but rather continued a pattern of topical coverage. The USOE report recommended implementation of more foundation courses (e.g., physical science, earth science, or life science) to prepare students better for high school coursework.

Prior to the mid 1950's, elementary and junior high school mathematics curricula tended to emphasize rote application of computational skills. In the mid 1950's, "modern mathematics" programs emphasizing logical structure and abstract principles were first developed (Riedesel and Burns, 1973). Since the mid 1950's, computation, fractions, and decimals are still at the core of elementary mathematics instruction, but with increased emphasis on student exploration, discovery, and inductive approaches (Suydam and Osborne, 1977). Geometry and algebra appear earlier in the curriculum, elementary algebra frequently being taught in the eighth grade.

Social studies instruction in junior high schools prior to the mid 1950's is more difficult to characterize than science or mathematics. Shaver and Larkins (1973) report that in the early part of the century the term "social studies" had been applied to the history and geography instruction of the 1800's. More recently, many social studies curricula were based on citizenship education. In the 1960's, a few curricula were developed which focused on the concepts and empirical content of the social sciences. Wiley and Race (1977) summarized typical social studies course offerings for the period 1955 through 1975. At the fifth

grade level, American or United States history is the most typical course offering throughout the entire twenty year period. The most typical courses offered in grades six and seven have been studies of different cultures. United States or American history has consistently been taught in grade eight.

This very brief review points out the similarity of the junior high curriculum to the departmentalized curriculum of the senior high school. The tendency for the junior high school to be a "watered down" or diminutive version of the high school has produced much criticism among educators. Some of these dissatisfactions are presented below.

Dissatisfactions with the Junior High School

Many educators have become dissatisfied with the traditional grade seven-eight-nine junior high school organization. By the mid-sixties, the trend toward earlier onset of puberty had proceeded to the point where the early adolescent period was better characterized as spanning grades five through eight than seven through nine (Fielder, 1978; Eichorn, 1966). Junior high schools that were typically patterned after high schools had failed to address the special needs of youth undergoing the physical, social, emotional, and cognitive changes of early adolescence. For these reasons, it has been suggested that students be educated in a setting that facilitates the transition from childhood to full adolescence. This dissatisfaction was one of the reasons for the emergence of middle schools in the mid 1960's.

The Middle School: A Proposal for a New Organizational Alternative

Middle schools typically include grades six through eight, but could include grades as low as five or as high as nine. They theoretically attempt to meet the unique needs of early adolescents by providing an institution which has an integrity distinct from that of the elementary or secondary school. The Middle School Association reports that of the roughly 10,000 schools serving grades five through nine, 4,006 are middle schools, most of the remainder are probably junior high schools. Stradley (1971) discussed ways in which the middle school can overcome the deficiencies of the junior high school in serving the needs of early adolescent youth. He emphasized the importance of maintaining flexibility in the middle school curriculum, and argued that "such programs as team teaching, independent study, continuous progress, individualized programming, and leveling must be considered important aspects of the middle school...Instruction based on flexible group sizes can be particularly effective at the middle school level" (p.47). In practice, while various distinctive instructional organizations, e.g. team teaching, have been implemented in many middle schools, it is difficult to specify just how functioning middle schools as opposed to junior high schools serve as institutions uniquely responsive to the special needs of early adolescents.

The potential of the middle school to serve early adolescents' needs. In the literature on middle schools a number of ideal characteristics are mentioned. These characteristics reflect the philosophy of educational practitioners as to the kind of schooling which should be provided for early adolescents. It should be noted that these characteristics could be found in junior high schools, as well as middle schools. Furthermore, the presumption that presence of these characteristics is of benefit to early adolescents requires further research. A list of these characteristics is found in a research brief by Educational Research Service (1975):

- emphasis on guidance and human relations

- emphasis on affective education as well as subject matter
- emphasis on individualized instruction and independent study
- less emphasis on competitive interscholastic athletics
- less emphasis on sophisticated socializing such as night dances and dating
- exploratory courses and activities to help students develop their own interests
- interdisciplinary teaching teams
- each student has one "home-based" teacher who gets to know that student really well
- diversity in teacher certification (including teachers trained at the elementary level, who may be more child-centered, and teachers trained at the secondary level, who may be more subject-oriented)
- flexible scheduling
- gradual transition from self-contained classroom to departmentalization

The features listed above represent components of the "ideal" middle school. The research on middle schools reviewed below indicates that "ideal" is by no means the norm. Middle schools are often established out of purely practical concerns, e.g. crowding of elementary classrooms, and in practice there are probably no characteristics which consistently distinguish middle schools from junior high schools. In the following section a brief sketch is presented of curricular offerings in science, mathematics, and social science in the middle school level.

Science, mathematics, and social studies courses in the middle school as compared to the junior high school. Systematic surveys of middle school curricula could not be located, since standard practice is to organize such data according to grade level, and only secondarily according to school organization. However, on the basis of a collection of eight profiles of "typical" middle schools compiled by Stradley (1971), middle school course offerings in the areas of mathematics, science, and social studies are quite similar to courses offered in grades seven through nine in a nationally representative sample of schools (RTI, 1977). All eight of the middle schools required each of science, mathematics, and social studies in all grades included, through grade eight. In grades five and six, only general science was available. General science was also most typical of grades seven and eight, sometimes taught in conjunction with health. One school offered an elective in Natural Resources. Arithmetic and general mathematics were the only mathematics courses taught in grades five, six, and seven, with algebra sometimes available in the eighth grade. Social studies was taught often in conjunction with reading or English. Civics and geography were taught in grade seven in one school, which also offered geography and history in grade eight.

McGlasson (1973) concludes that research has indicated no essential differences between the course offerings of middle schools and the junior high schools which existed prior to their establishment, except the possibly earlier introduction of homemaking and technical arts. On the other hand, he suggests that middle

schools may have made greater use of innovations such as mini-courses, learning packets, independent studies, team teaching, continuous progress, individualized instruction, and unified curricular approaches.

There are two other important criticisms of the middle school movement. One criticism is related to the expressed concern for improving the quality of education offered to ten to fourteen year olds. Alexander (1969) asserted that many middle schools are opened for solely administrative reasons such as dealing with overcrowding or advancing racial integration. Moss (1969) pointed out that male teachers, who enjoy working with seventh through ninth grade students, may be more reluctant to work with students in grades five through eight. In the light of this, opening middle schools may cause male teachers to move into the secondary schools.

The effectiveness of the middle school cannot be determined through the use of lists of ideal characteristics. The remainder of this section of the report will summarize some of the available research.

Research on the Effectiveness of Middle Schools

Two studies reviewed by Lipsitz (1977) may have implications for school organization. McPartland and Epstein (1973) at the Johns Hopkins Center for Social Organization of Schools have examined the effects of open environment (defined by variety of activities permitted, individualization, and student participation in selecting assignments, monitoring progress, and setting goals) on 7,000 children in grades four, five, six, eight and eleven in thirty-four schools. The investigators examined variables including reactions to schools, decision-making, self-reliance, and standardized achievement test scores. Results suggest that eighth grade students demonstrated an overall positive benefit from attending open schools. The positive effects are strengthened as students stay in the environment longer. Results obtained by McPartland and Epstein in support of open schools for eighth graders were substantially stronger than results at the sixth grade level. This is of significance, given that many more such programs have been devised for sixth grade pupils than for eighth graders. The contrast between findings at these two age levels within early adolescence also points to the great heterogeneity of this period, and highlights the necessity for schools to attend to the specific needs of youth at different points within the early adolescent period.

The second of the studies Lipsitz reviews bears upon the desirability of grouping grades six through eight rather than grades seven through nine in a single building. Simmons, Rosenberg, and Rosenberg (1973) have studied self-image during the early adolescent period. The researchers concluded that this was a period of extreme self-consciousness and changing body image, and that a definite disturbance in self-image occurs during this period. The age of twelve, i.e. the period between the twelfth and thirteenth birthdays, was found to be especially critical, and problems were exacerbated by a break in schooling patterns between the sixth and seventh grades suggesting that middle schools might be better matched to the developmental patterns of early adolescence.

Educational Research Service (1975) reviewed nineteen research studies that examined middle school students, parents, and teachers. These studies generally did not employ rigorous experimental designs, and many appeared to suffer various methodological flaws. In spite of these weaknesses, the body of studies as a whole offers some insight into the effects of middle school versus traditional organizations.

Achievement and attendance. Five studies compared the achievement of middle school students with that of students of more traditional settings. Of these five

studies, three reported results that slightly favored middle school students (Case, 1970; Evans, 1970; Trauschke, 1970). Case (1970) found that in reading achievement and mathematics average gains over one school year were significantly greater for fifth grade middle school pupils than for fifth graders in an elemantary school, as measured by standardized achievement tests. Evans (1970) found a mixed pattern of results when comparing eighth grade students in two middle schools versus two junior high schools. Total scores on the Iowa Tests of Basic Skills showed no significant differences between the two organizational patterns, but middle school pupils did attain higher scores on reading and study skills subtests. Trauschke (1970) found scattered statistically significant differences on subtests of the Stanford Achievement Test favoring seventh and eighth grade pupils in a grade five through eight middle school to those in a comparable junior high school. No differences between fifth and sixth grade pupils and their counterparts in a traditional elementary school were found.

Results of these studies are difficult to generalize, because of the wide variation in middle school and other programs. Two other studies reported found no significant differences between middle school and other organizations. The appropriate unit of analysis in studies of this kind would be the school, rather than the pupil. Taken as a whole, this research does not support the contention that measured achievement in middle schools is superior to that under other instructional organizations. Since the distinction between middle and junior high schools is so vague, it is not possible to attribute either failure or success to any specific school characteristics on the basis of these studies.

Two comparisons of attendance at middle schools versus other schools were reported. One was a part of the study by Evans cited above and the other was a study by Mooney (1970) that employed the same middle schools as the Trausche study. Evans found no significant difference in attendance rates between study and control schools, but Mooney found strong differences favoring the middle school.

Self-concept and attitude. Nine studies were reviewed that compared the self-concepts and attitudes of students in middle schools to students elsewhere. The pattern of findings in this area was even less clear than for attendance and achievement. Three comparisons showed small but statistically significant differences favoring middle schools, four were unfavorable to middle schools, one study showed no significant differences, and one showed mixed results. Individual studies used a wide variety of instruments with numerous subscales, and no clear pattern characterized results across schools or across grade levels. Accordingly, individual studies will not be listed. Taken as a whole, these studies indicate only that middle schools may, but need not, be superior to other organizations in promoting desirable affective outcomes.

Teacher and parent attitude. Four studies of teacher attitudes toward the middle school were reported. One of these, by Gatewood (1970), was noteworthy in that surveyed teachers were sampled from middle and junior high schools in five states, providing more of a basis for generalization of the findings. Gatewood developed a survey instrument that described thirty-nine functions of education at the middle school/junior high level. It included such functions as: guidance, transition from elementary to secondary education, provision for exploratory analysis, etc. Respondents indicated to what degree these functions were accepted and implemented in their schools. Although there were several differences between middle school and junior high teachers, when respondents rank-ordered the functions from most to least accepted and implemented, the rank orders for middle and junior high schools were highly associated. In general, junior high school teachers indicated greater acceptance of goals, but middle school teachers indicated a higher degree of implementation. The other three studies of teacher attitudes showed mixed results. All three were confined to teachers within a single school

district. One of these studies also reported comparisons of attitudes among parents of children in middle versus junior high schools toward their children's schools. Results were very similar for the two groups.

Comparisons of administration, organization, and curriculum in middle schools versus junior high schools. Eight studies in this area were reported. Most of these (five) led researchers to conclude that "middle schools and junior high schools were more alike than different" with regard to organization and curriculum. Results of the remaining three studies were mixed. Gatewood (1970) noted that the middle schools in his sample had been formed more often out of administrative necessity (to reduce overcrowding) than out of a desire to implement educational innovations.

Summary

There are differences in the philosophy of the middle school and the junior high school, but the practical distinction between the two is unclear. While junior high schools generally encompass grades seven through nine, and while middle schools serve various gradespans in the range from five through nine, curriculum and instructional practices may be quite similar in the two settings. The variability among schools is greater than the difference between the two school types.

Given the lack of distinction between middle schools and junior high schools, the failure of research to establish the superiority of one or the other is not surprising. Studies in which specific characteristics of schools were more carefully identified might provide more useful results.

Implications

- Early adolescence is a period marked by dramatic physical, cognitive and emotional changes. For most youth, one or more transitions in patterns of school organization will also occur during this period. Along with these organizational changes (e.g. moving from the elementary school into the middle/junior high school) comes an increase in the rigor demanded by science, mathematics and social science instruction. The coordination of changes within the learner and changes in instruction is an area of needed research.

- The nature and purpose of science, mathematics and social science instruction at the middle/junior high school level needs to be evaluated in the context of instruction from grades K through twelve and beyond. The provision of relevant, motivating instruction at this level may be critical in encouraging further study and ultimate career selections in these areas.

- A specific review of science, mathematics, and social science practices and curricula in middle schools and junior high schools would be useful.

- Research on middle versus junior high school organizations does not consistently favor either type of school. This suggests that a more useful focus for research would be the outcomes of specific curricula and/or instructional practices, regardless of the type of school in which they are implemented.

Teacher Preparation and Certification

Stradley (1971) pointed out the lack of professionally trained middle school teachers, a problem that has plagued junior high schools as well. Many middle school and junior high school faculties include one group of teachers with elementary school training and experience and another group with secondary school training and experience (George, McMillan, Malinka, Pumerantz, 1975). There are only a few teachers at this level who have had both elementary and secondary training and experience. Thus, most of these teachers see themselves as either "secondary" or "elementary" teachers with no strong identification to the intermediate grades.

The National Center for Education Statistics (NCES) has published information on the training of junior high school teachers. According to NCES figures (NCES, 1975) a total of 592 bachelors degrees, 123 masters degrees, and no doctorates were granted in junior high school education in the United States in 1971-1972. These degrees were awarded by a total of 39 different institutions. About one-third of the bachelors degrees and half of the masters degrees were earned by men. More recent data indicate that even fewer degrees are now being awarded in this area (NCES, 1978). In 1975-1976, only 255 bachelors degrees, 105 masters degrees, and no doctorates were granted. These degrees were awarded by 37 different institutions. Comparisons between the 1971-1972 and 1975-1976 data should be made with caution. The data may indicate a decline in interest in obtaining certification for junior high school teaching, but other explanations are also possible. First, declining enrollments in colleges of education have led to reductions in numbers of degrees granted. Second, there is little overlap between the 39 institutions granting degrees in 1971-1972 and the 37 institutions granting degrees in 1975-1976. This may suggest that reporting of these statistics was somewhat incomplete.

While NCES has not published information on middle school certification, a number of other surveys are available. The surveys summarized below were conducted by individual researchers studying the middle school movement. These are concerned with middle school certification requirements recently established in many states, rather than numbers of professionals being trained. The first national survey of middle school certification patterns was conducted by Pumerantz (1969), who reported that official certification requirements for middle school teaching had been established only in the states of Nebraska and Kentucky. Nine other states were in the process of planning new certification requirements (see Table 2). George et al (1975) indicated that between Pumerantz' survey and 1975, a number of important actions occurred in the middle school movement. First, the number of middle schools doubled, with the middle school pattern of organization becoming predominant in several states. In addition, the National Middle School Association developed, and state associations were formed in at least eight states. Given these changes, George et al (1975) conducted a survey of the fifty states to document any further changes in certification or teacher training. Results of the survey showed that forty-seven of the fifty states had officially recognized (through their state departments of education) middle schools in operation. The three states that did not have officially recognized middle schools actually had schools that considered themselves to be middle schools. In 1975, only eight of the fifty states reported a teacher's certificate specifically for the middle school (George et al, 1975). These states accommodated teachers who were already placed in middle schools prior to adoption of the state certificate, allowing them to teach in the middle school with either an elementary or secondary

Table 2

Trends in Middle School Certification

Year of survey	No. of states with middle school certification adopted	No. of states considering middle school certification	No. of states not planning to change certification
1968	2	9	39
1975	8	14 or 15	27 or 28
1978	13	13	24

certificate. So, in the eight states that had adopted a middle school certificate it was not really a mandatory condition for placement in middle schools. Typically, teachers with elementary certificates could teach in grades five and six in the middle school and teachers who had secondary certificates could teach in grades seven and eight, but only in the subject areas for which they were certified. Florida proved to be an interesting variation. Teachers who had a secondary certificate could teach in their subject area in all grades seven through twelve, regardless of whether the school was called a junior high or middle school. However, a teacher with a middle school certificate could teach only in recognized middle schools. Obviously, this limited job opportunities for individuals certified as middle school teachers. Six of the eight states with middle school certification required a subject matter specialization similar to that for secondary school certification. In these six states the middle school certificate is valid only in the area of specialization. For the remaining two states the school certificate is valid for all subjects taught in the middle school. This approach facilitates interdisciplinary instruction.

Referring to Table 2, in 1975 there were fourteen or fifteen states that planned to undertake middle school certification or at least had the issue under study. In Colorado an administrator's certificate for middle school was adopted. The certificate required a master's degree plus fifteen semester hours in Middle School and/or Junior High School courses, as well as three years of appropriate teaching experience. Nine other states were considering similar plans in 1975. All other states considered their current administrators' certificates to be adequate. The only state that adopted certification for special personnel was Montana. This included certification for physical education teachers, music teachers, and other special teachers. No other states were considering similar action.

Data in Table 2 on the number of states with middle school certification procedures in 1978 were obtained through personal communication with the Middle School Resource Center. As shown in Table 2, there has been an increase from two to thirteen states with middle school certification in the years since 1968.

Teacher education institutions have reflected the increasing need for middle school teachers through the development of preservice programs as well as university courses. In 1975 nineteen states reported some activity directed toward middle schools in their universities. The level of activity ranged from one undergraduate course on the middle school to an entire degree program.

Implications

- The unique educational needs of early adolescents call for teaching professionals especially interested in and trained to work with this age span. The normal, healthy majority of early adolescents as well as those with special difficulties should be served by persons with such training.

- Historically, such training has not been widely available, and most teachers have specialized in either elementary or secondary school instruction.

- Preservice and inservice programs may be especially helpful to middle/junior high school science, mathematics, and social science teachers who were not trained specifically to work at the early adolescent level.

Staff Support

To instruct effectively, teachers require resources of many kinds. These include not only curricular materials, but also equipment and expendible supplies and personnel resources in the form of supervisors and/or classroom aides. If teachers are to remain abreast of new instructional technologies, they also require information about new teaching methods and curricula. This section presents data on support services provided and needs perceived by middle/junior high school teachers of science, mathematics, and the social sciences.

Sources of Supervision and Curricular Information for the Classroom Teacher

Important sources of staff support for classroom teachers are state and district supervisors, as well as principals and department heads. Data collected in a variety of studies suggest that there are few supervisory personnel and inadequate dissemination of curricular information at all grade levels.

The RTI survey (RTI, 1977) documented that many states have fewer state-wide subject area coordinators than previously. Nearly two-thirds of local school districts do not employ supervisors. Results from the district level questionnaires used in the RTI survey indicated that roughly thirty-three percent of the respondents had never seen federally developed materials in mathematics and the social sciences, and roughly thirteen percent had never seen federally developed science curriculum materials. In addition, nearly seventy-five percent of the principals surveyed perceived themselves as "not well qualified" to supervise mathematics and science.

Given such inadequate support from the school, district, and state levels, it is not surprising that "other teachers" were reported to be a major source of information on curriculum materials by fifty-seven percent of the grades seven through nine teachers surveyed for the RTI document. College courses were reported to be a major source of information by fifty-four percent of the respondents. Only eighteen percent of the grade seven through nine teachers found local inservice offerings to be of value. Even fewer saw the principal as a major information source.

Aides to Assist the Classroom Teacher

More staff to assist in the classroom are seen as a major need by classroom teachers. The RTI (1977) survey reported that in each of the areas of science, mathematics, and social sciences, the lack of availability of lab assistants and/or paraprofessionals is rated as a major problem by teachers.

Facilities, Equipment, and Supplies

Teachers reported in the RTI (1977) survey that they needed or would use if available a wide range of facilities, from weather stations and greenhouses to calculators or additional small-group instructional space. The following results indicate the need for increased expenditures. These results are representative of needs and/or conditions reported by junior high school teachers.

Fewer than fifty percent of the grade seven through nine schools surveyed reported specific budgets for science equipment and supplies, and these averaged $9.01 per student. For grades four through six, roughly one quarter of the schools specifically budgeted science equipment and supplies, the per pupil average budget being $4.22. In the area of mathematics, over twenty-five percent of the grade seven through nine mathematics teachers reported that calculators were

needed but not available. The principal need expressed by social studies teachers was for increased space for small group instruction.

Utilization of Federally Funded Curriculum Packages

As part of the RTI survey, principals were asked to list federally funded curricula in science, mathematics, and social studies in use in their schools. Results showed that twenty-two percent of grade seven through nine schools used at least one mathematics curriculum package, the average being .6 such packages. Thirty-nine percent of the grade seven through nine schools used at least one federally developed science package, the average being 1.6 packages. Thirteen percent used at least one federally developed social studies package, and these schools averaged 0.9 such social studies curricula.

The Need for Increased Inservice Programs

Schools and districts generally appear to be providing little inservice support. Hofman (1976) reports a survey of middle/junior high school science teachers conducted for the National Science Teachers Association. Ninety-seven percent of those responding had not been trained for work at the junior high school level. Many teachers expressed a desire for more local workshops through the National Science Teachers Association. Osborne (1977) noted that as numbers of supervisors decrease, the school districts lack the capability and the resources for inservice education, which further underscores the need for increasing inservice education programs. Osborne (1977) also reported that thirty-five percent of a sample of mathematics supervisors estimated annual expenditures exclusive of salary for teacher inservices at less than one dollar per teacher. Less than twenty-five percent of the sample of mathematics supervisors estimated expenditures at over $5.00 per teacher.

Implications

- There is a critical lack of current information among middle/junior high school science, social science, and mathematics teachers. As traditional information sources such as curriculum supervisors and statewide coordinators have become less common, the importance of curriculum information dissemination via teacher centers, workshops, and inservice education activities has increased. Only limited data are presently available on perceived teacher needs and information sources specific to the early adolescent period.

- Policymakers in local educational agencies may need more information on requirements for equipment and supplies to teach science at the middle/junior high school level so that more realistic budget levels might be attained.

Science, Mathematics, and Social Science Instruction for Early Adolescents

This section describes instruction for early adolescents in the three content areas of science, mathematics, and social science. Instructional practices and related research in each of these areas are described, and following each description implications are drawn.

Current Science Instruction for Early Adolescents

At the intermediate grades in the mid 1950's, science instruction was largely textbook bound. Emphasis was on learning facts, and texts were used to cover a large body of content. In the early 1970's, there was a tendency to reduce the amount of content to allow for more in-depth treatment of the material, less reliance on the text, more "hands on" science, and better content organization. A greater variety of materials came into use (Helgeson et al, 1977). Current concerns such as "pollution, natural resources, and energy" received more attention in recent curricula, as did the concepts and processes of science, attitudes toward science, and laboratory experiences.

More recent data on the actual degree of utilization of various materials in the classroom are difficult to obtain. However, there are some indications of a trend in the past two or three years back toward greater reliance on the text, more factual content, and less "hands on" science. Perhaps due to increasing concern for basic skills and/or due to financial constraints, a shift toward more reading, and less laboratory experience, and fewer field trips was reported to characterize recent junior high school instruction (Stake, 1978). Stake has also suggested expense, discipline problems, and emphasis on tested outcomes as factors contributing to a general reduction in laboratory work.

Stake (1978) presents data suggesting that science instruction is viewed as serving different functions in the elementary and secondary curricula. For the elementary school teacher, science is of secondary academic importance. It should be fun for pupils of all abilities, and should give slower pupils a chance to participate. In the high schools, science courses are seen as difficult, and accessible only to the intellectual elite. This may be because of the mathematics preparation required for chemistry and physics. Biology is taken by the majority of high school students. The shift in attitude from science as fun in elementary school to science as difficult and demanding in high school could help explain the substantial attrition in science enrollments after ninth or tenth grade biology.

In grades six, seven, and eight an average of twenty-two to twenty-eight minutes per day are devoted to science instruction according to Helgeson et al (1977, p.32). RTI (1977) reports student use of hands on materials at least once a week in sixty-one percent of grade seven through nine science classes. Lecture, discussion, and individual assignments were reportedly used at least weekly in seventy-eight, ninety, and forty-seven percent of grade seven through nine science classes, respectively. On the average, grade seven through nine science students spent forty-nine percent of their time in whole-class instruction, thirty-five percent working individually, and the remaining sixteen percent working in small groups. Small group work would be a typical pattern for hands on science.

According to the RTI (1977) report, forty percent of grade seven through nine science teachers considered inadequate student reading ability a serious problem. Large percentages of teachers also regarded as serious problems (1) lack of materials for individualizing instruction (twenty-seven percent), (2) inadequate facilities (twenty-six percent), (3) insufficient funds for equipment and supplies (twenty-four percent), (4) large class sizes (nineteen percent), and (5) lack of

student interest (nineteen percent).

Instructional Research in Science

In determining what is known about science instruction and the early adolescent, three recent summaries of research in science education were reviewed (Rowe and Deture, 1973; Herron, Jaus et al, 1975; and Malinson, 1977). Only those findings relevant to early adolescence are discussed in this document. It should be pointed out that these reviews were chosen because they were the most recent available, but each summarizes research conducted during only a single year. Therefore, the conclusions drawn relate to the most current concerns. While a substantial body of literature on this age range has appeared in recent years, it constitutes only a small proportion of the studies published (Ayers, 1974). Many important studies have also included either older or younger children. Accordingly, a few studies appear in the following review that were not concerned exclusively with early adolescents.

Research based on the Piagetian model. As described in Part I of this document, some youth begin to attain formal operations during early adolescence. Thus, science instruction during early adolescence can make more effective use of logical operations, critical thinking and heuristics than science instruction for younger children. Numerous studies have appeared examining the incidence of formal operations at different age levels, the relation of formal operations to academic achievement in science, and the efficacy of direct instruction in logical abilities. In general, research indicates that a large proportion of early adolescents are still at the concrete operational level (Kavanaugh, 1973; Chiappetta, 1975; Abramowitz, 1975), and that attainment of formal operational abilities is related to science achievement (Sayre and Ball, 1975).

Studies of direct instruction in logical abilities have generally reported positive results. While these studies have demonstrated that early adolescents can learn to apply logical operations in performing specific tasks, these studies do not imply that such learning would transfer to a broad range of situations. Hadar (1975) used concrete materials to train fifth graders to distinguish valid syllogistic patterns from the fallacious patterns of Affirming the Consequent and Denying the Antecedent, and reported significant achievement gains. Quinn and George (1975) reported success in teaching hypothesis formation to sixth graders. Walding (1975) reported success in teaching classification to seventh graders. Nous and Raven (1973) examined the effect of Piagetian-based structured learning experience on children's correlative thinking about biology, and found that while ninth graders did benefit from the training, results were doubtful for fifth and seventh graders. Hammon and Raven (1973) studied the impact of using a structured set of exercises to help sixth and eighth graders learn tasks involving four logical operations. Results indicated that students who received instruction on similar tasks performed better on the criterion measure, with eighth graders benefitting more than sixth graders. Their conclusion was that students at the formal level can profit from such training. There is also evidence that the SCIS science program helps to develop conservation of perimeter, weight, and volume (Hanson, 1973), and the ability to explain compensating variables (Linn and Thier, 1975).

One noteworthy study by Golshan (1973) employed a clinical method similar to Piaget's to investigate one eleven year old girl's thought processes about physical phenomena. The study lasted three months. Results showed that the child had a coherent, self-consistent and interwoven structure that guided her explanations. This type of study would shed more light on how to present content and instruction well suited to children at particular developmental levels.

Studies of instructional methods. One instructional method which has been widely investigated is the use of behavioral objectives, that is, students are informed prior to instruction of what they are expected to learn. None of the research reported in the three reviews on behavioral objectives dealt specifically with the middle/junior high school level, but findings offered no firm empirical basis for the use of behavioral objectives at other levels.

Research on the use of advance organizers has also shown no consistent effects (Barrow, 1974; Lucas and Fowler, 1975). One related study by Wilson (1973) examined the effects of generating hunches upon subsequent search activities in problem situations. A sample of forty-five nine to eleven year olds observed a "discrepant event", and one-third were required to produce hunches concerning the solution of the problem. The pupils who generated hunches outperformed a group which read a list of hunches, and a control group, in classifying a list of solution procedures as to usefulness. The reviewers (Rowe and Deture, 1973) suggested that the activity of generating hunches may have served as an advance organizer.

Studies of general instructional approaches (e.g. mastery learning, individualized instruction, or instructional pacing) offer no strong support for any one approach. Okey (1974) investigated mastery learning, using eighteen K through eight inservice teachers. Mastery learning is a method of organizing instruction developed by Bloom (1976) in which one to two week units of instruction are followed by brief tests of the content just covered, and "feedback and correctives" are used to assure that all or almost all pupils attain mastery before proceeding to the next unit. It has been found to be most successful with mathematics materials which are highly structured and sequentially organized. After receiving training in mastery learning, each teacher taught one class using the technique and another not using it. Results showed no advantage for either method, but teachers were more favorable toward the mastery learning approach. Two studies of science instruction contrasted the ISCS curriculum to traditional courses. Stallings (1973) contrasted "individualized" (ISCS) versus more traditional instruction for students in grades seven through nine. No differences were found at the seventh and eighth grade levels, but in grade nine, differences favored the non-ISCS group. Gabel (1975) studied instructional pacing using ISCS materials at the seventh grade level. The strategies contrasted were 1) giving students a deadline for the completion of each unit and 2) offering unlimited time but holding students to a mastery criterion for each unit covered. In addition, strategies of having students work alone versus in pairs were compared. As might be expected, self-paced students covered fewer chapters, but showed greater learning and retention on material covered, than did teacher-paced students. Attitudes of the two groups toward ISCS did not differ. Among low-ability students, those working with a partner showed better retention than those working alone. One additional study concerned the ISCS curriculum. Atkinson (1973) found that eighth graders who were poor readers were helped when ISCS instructions were presented orally. Few of the studies of general instructional approaches dealt with expository versus discovery methods during the period covered by these reviews, and no studies were located contrasting these methods for early adolescents.

Several additional studies of instructional method dealt with topics difficult to classify. In a study of duration of training and retention, Tomera (1973) found that students who learned an analytic style of inquiry in junior high school retained this style into the twelfth grade. Use of a one day field trip to the Fernbank Science Center (Lucas, 1975) and outdoor laboratory investigations (McNamara and Fowler, 1975) were shown to have positive effects,

especially on attitudes, for junior high school students.

Teacher questioning and wait time. Several studies of teacher verbal behavior in early adolescent science instruction were reviewed. Most of these studies dealt with questioning behavior and with the amount of wait time that followed questions. Medoff (1974) performed a study relating pupil verbal interaction with ability, self-image, and teacher questioning behaviour, using 221 seventh grade students. Four subject areas were studied. Some results were as follows: 1) higher-level questioning and higher-level student reponses were more likely in English and social studies than in science and mathematics; 2) verbal participation was not correlated with student reading ability or with self-image; and 3) verbal participation in all four subject areas was 2.5 times as great for males as for females.

Lake (1974) manipulated wait time following teacher questions in the presentation of three SCIS science lessons to fifth graders. Increased wait time resulted in more student inquiry behavior and more cognitively complex responses. Given the relation of wait time to student participation, a finding by Campbell (1973) merits careful attention. Utilizing his method of analyzing chains of teacher behavior, Campbell has found that junior high school teachers give less response time to poor students.

Attitudes toward science. A number of studies have shown a decline in the attitude of junior high/middle school students toward science. Beginning at about grade six, students' positive attitudes toward science diminish, and this trend continues through the junior high years (Ayres and Price, 1975; Randall, 1975; Bohardt, 1975). Ayres and Price (1975) devised a science attitude inventory and compared the attitudes of fourth through eighth graders. They found that fourth graders liked science better than eighth graders. The percentage of fourth graders who believed science information would always be valuable to them after graduation was fifty-seven percent, but only fourteen percent of the eighth graders concurred. Few students from either age group liked to read about science at home. Fifty percent of all students liked field trips, but thirty-eight percent had never been on one. Fourth and fifth graders had positive attitudes, but sixth graders had many negative attitudes. Nevertheless, thirty-seven percent of all the students preferred science to other subjects. Randall (1975) developed an instrument to measure attitude toward science as a school subject, science content, and science teaching. He surveyed a large sample of eighth, tenth and twelfth grade students. A number of conclusions were formulated, but the "highlight" of the study was that the attitudes and perceptions of students at all grade levels toward science as a school subject were negative. Finally, Bohardt (1975) assessed the attitudes of children in grades four through eight toward process-oriented science programs. Fourth and fifth grade students responded positively to process-oriented programs, but attitudes deteriorated rapidly with increasing grade level. Still, there were more positive responses than negative at all grade levels. Half of the fourth and fifth graders thought science was fun, but this perception diminished significantly beginning with sixth grade.

The overall decline in early adolescents' attitude toward science is critical. Each of the three studies reviewed above reported this decline and taken together they provide evidence of a phenomenon worthy of further investigation.

Teacher education. The research on preparation of junior high/middle school teachers points to a strong need for improved teacher education at this level. Although there are not large numbers of studies done on this topic, the few there are have strong implications.

Lawrenz (1974) surveyed 344 practicing junior high and high school teachers. the senior high school teachers rated themselves significantly higher than did

the junior high teachers in the following areas: effectiveness of lectures, knowledge of subject matter, career opportunities, and evaluating the effectiveness of teacher performance in the classroom. The only area where the junior high teachers rated themselves higher than did the secondary teachers was in the use of audio-visual presentations. Faber (1974) also conducted a survey of junior high and senior high school teachers. He surveyed 475 teachers and found that when junior high school and senior high school teachers were asked to rate the training they had received in science content and methodology, the junior high school teachers viewed their teacher training as much less adequate than did the senior high school teachers.

Research on science education for special groups. There has been an increase in the number of studies conducted on special groups such as the physically handicapped, bilingual students, and low income groups. One interesting study was conducted on a sample of ten to thirteen year old deaf students (Boyd and George, 1973). It was found that these students could improve their ability to classify objects by properties after engaging in science activities similar to those in SAPA and SCIS. It is impossible to generalize any results from this literature, as it is just beginning to accumulate.

Implications of Early Adolescent Science Research

- Research on the Piagetian model indicates that many early adolescents are not at the formal operational level. Reliance of current science curricula on formal operational abilities should be investigated. New curricula or supplementary materials may be indicated.

- Numerous instructional sequences have been used with apparent success to teach specific logical operations or analytical procedures. These methods appear to be most effective with children at the eighth grade level or above. The lower limit of age for effective instruction of this type should be determined, and ways to facilitate transfer to new materials should be investigated.

- Teacher preparation for middle/junior high school science is an area of critical concern. Studies indicate that junior high school teachers believe their science content and methodology to be inadequate.

- Deteriorating attitudes toward science between the sixth and tenth grades indicate that early adolescence is a critical period in maintaining and/or developing positive attitudes toward science. The possible linkage between increasing rigor and/or decreasing relevance in science instruction and increasing student dislike should be researched.

- The incorporation of informal educational experiences, e.g. trips to museums, zoos, planetariums, into the science curriculum is increasingly advocated. Limited research indicates that youth have positive attitudes towards such activities. Research on other effects of informal education and on the integration of such experiences into the curriculum is needed.

Current Mathematics Instruction for Early Adolescents

Instruction in mathematics is primarily determined by textbooks. In the great majority of classes, a single text is used, and "there is a rather firm

adherence to covering the material in the text, although sections which teachers do not consider important...may be ignored" (Suydam and Osborne, 1977, p.P-84). Elsewhere it is stated that "the inclusion of 'new math' content in the elementary school (K-eight) may be illusory" (p.P-35). According to the RTI survey, students were reported to use hands-on manipulatives or laboratory materials at least once a week in only twenty-one percent of grade seven through nine mathematics classes. Corresponding figures for the use of lectures, discussion, and individual assignments and quizzes were eighty-six, eighty-seven, seventy-four, and seventy-four, respectively. Forty-five percent of grade seven through nine mathematics instructional time is used in whole-class instruction, thirty-eight percent in individual work, and seventeen percent in small group settings. Instruction averages forty-two minutes per day for mathematics.

Instructional Research in Mathematics

Only a small fraction of the research in the teaching and learning of mathematics deals specifically with the early adolescent period. The studies reported or referred to in this section were all judged to bear significantly on middle/junior high school instruction, but it was necessary to include a few studies employing older or younger pupils.

Research based on the Piagetian model. As indicated above, early adolescence is often a period of transition from concrete operational thought to more formal operations. Prior to this transition, the child acts to order what is immediately present, and can apply rudimentary logical operations in dealing with arrangements of objects, but does not yet possess the adult capacity for abstract thought. The emerging formal thought has been characterized as hypothetico-deductive, propositional, and involving combinatorial reasoning. Thus, this transition marks a substantial change in the mathematical ability of the early adolescent (Flavell, 1963).

As reviewed earlier, there has been substantial research on scientific reasoning during early adolescence. Harrison (1969) reviewed eighty studies dealing with Piaget's theory and related them to mathematics learning and instruction. He drew upon experiments reported by Inhelder and Piaget (1958) to argue that adolescents at the formal operational level could avoid errors made by concrete thinkers by applying the sixteen binary operations of formal logic to develop systematic strategies. Youth at the formal level were able to isolate the variables relevant to the solution of a problem. Harrison also describes a theory of mathematics learning by Skemp (1958), supported by research with students aged twelve through sixteen. He found that the ability to form concepts and to manipulate them was highly correlated with mathematics achievement. Suppes and Binford (1965) investigated teaching mathematical logic to bright fifth and sixth graders, and compared their performance with that of college students. The results showed that the upper twenty-five percent of this group could achieve at a level approaching that of college students.

Studies of instructional methods. One instructional method which has been applied effectively in middle/junior high school mathematics instruction is mastery learning (Block, 1970; Collins, 1970; Kersh, 1970; Kim, 1968). As described above, the mastery learning approach involves dividing course content into learning units, typically of one to two weeks duration, and testing at the end of each unit to assure mastery before proceeding. Mastery of prerequisites prior to beginning each learning unit is thought to be especially critical in an area such as mathematics, where each unit of content tends to be highly dependent on previous instruction. In each of the four studies cited above, a

higher proportion of students in mastery learning classes than in control classes attained criterion levels on subject matter tests, and the gaps between experimental and control groups tended to increase on successive learning units. Studies by Block and Collins also reported positive effects on attitudes when an appropriate level of mastery was maintained.

Research has failed to establish the superiority of either ability grouping or whole-class instruction in mathematics. Wallen and Vowels (1960), and Goldberg, Passow and Justman (1966), in studies of mathematics ability grouping with early adolescent students, showed little difference in adjustment or achievement related to grouping patterns. Davis and Tracey (1963) summarized research on intraclass grouping, and concluded that no one grouping plan is best. Another somewhat related issue is whether early adolescents learn mathematics better in a departmentalized classroom or a self-contained classroom. No differences in mathematics achievement scores between departmentalized and self-contained classrooms were found in studies by Finley and Thompson (1963), or Melfussel (1960). In addition, there appear to be no differences in achievement for early adolescents exposed to team teaching versus self-contained classrooms (Jackson, 1964; Lindgren et al, 1964). It appears that organizational procedures have little systematic effect on mathematics achievement (Riedesel and Burns, 1973). As in other areas, research on more clearly defined, more specific characteristics of instruction might prove more useful.

Teaching strategies. There are many teaching strategies that have been utilized with early adolescents. One of the most researched has been the discovery-oriented teaching approach, which is often contrasted with an expository approach. Worthen (1968) obtained results comparable to findings of other such comparisons: the retention and transfer of the discovery students was better than the expository group. However, the expository group had better immediate recall. Price (1965) investigated the use with tenth graders of materials designed to teach the transfer of critical thinking to non-mathematical materials, in conjunction with a discovery approach. He reported that discovery materials and transfer materials were mutually enriching, and their use resulted in affective as well as cognitive improvement over a control group exposed to traditional instruction. The well established findings that indicate "meaningful" teaching is a superior technique to "mechanical" teaching also characterize classrooms of early adolescents (Riedesel and Burns, 1973).

Other teaching strategies have been based explicitly on the goals of teaching critical thinking, and of promoting transfer to non-mathematical content. Fawcett (1938) reported success with a curriculum for demonstrative geometry that was designed specifically to help senior high school students to analyze critically putative proof in everyday life, and which used non-mathematical materials to facilitate the transfer of logical analytical procedures to non-mathematical content. Ulmer (1937) provided additional support for the use of geometry as an aid in developing ability in logical thinking. Taking the idea of proof as pivotal to mathematics, Smith and Henderson (1959) argued that the systematic development of this concept from the early grades through high school should lead to more careful and disciplined thought not only in mathematics but in considering everyday problems as well. The authors distinguish the probable inference of everyday life, characterized by the notion that proof is whatever convinces, from the more formal necessary inference of mathematics. A series of specific teaching strategies related to each kind of proof are identified. The authors also assert that one objective of mathematics instruction should be to teach students to distinguish among the truth of the reasons (givens), the validity of the inference, and the truth of the conclusion in any proof.

The teaching of problem-solving skills has been subject to more research than any other single topic in mathematics instruction. These include the skills necessary to ascertain what is to be found in a given problem and to select appropriate mathematical operations to apply to reach a solution. For example, skills of translation of word problems into equations, classification to recognize similar problems encountered before, and generalization to apply familiar methods in new contexts are all problem-solving skills. Many researchers have identified a variety of factors related to success in solving problems. The following factors seem to be related to problem-solving at all age levels: intelligence, computational ability, ability to analyze problems, mathematics vocabulary, being able to detect irrelevant detail, and knowledge of mathematical concepts. The setting of the problem to be solved is also important to achievement in this area. One major conclusion is that performance is facilitated when the problem is placed in a "relevant" setting (Riedesel and Burns, 1973). A variety of researchers have suggested specific techniques to help pupils solve problems (Riedesel and Burns, 1973). A few of the techniques mentioned are: (1) using drawings, (2) using a model problem, (3) using problems without numbers, (4) writing mathematical sentences, and (5) sequencing problems from easy to hard.

In addition to these overall approaches to mathematics instruction and broad organizing principles such as proof and problem-solving, many studies have explored particular methods for teaching decimals, percentages, and other specific topics. Two examples of such studies are as follows. Learning to place decimal points properly has been troublesome to many early adolescents. Grossnickle (1932) found twenty-one kinds of errors in division with decimals. He recommended "meaningful teaching" as the key to the problem regardless of what specific instructional procedure (e.g. inserting a carat) was employed. In teaching percentages, Wynn (1966) compared three methods: unitary analysis, formula, and decimal method. He found no difference in achievement or retention.

Mathematics instruction and learning styles. Several investigators have posited distinct learning styles, or cognitive styles, which characterized different learners. Usually it is argued that when some aspect of instruction is adjusted to reflect the style of the learner, performance will improve. In other words, different instructional strategies should work best with children who have different cognitive styles. Examples of stylistic variables that have been proposed include high versus low conceptual level (Hunt, 1971), field independence-field dependence (Witkin, 1973), and reflection-impulsivity (Kagan, Moss and Sigel, 1963).

Several stylistic variables have been researched, but a comprehensive review of research on aptitude-treatment interactions by Cronbach and Snow (1977) indicated little systematic evidence of interactions between stylistic variables and instruction. For those interactions that have been found, it is not always clear that it is learning style rather than general ability that accounts for the interaction. No consistent findings appear to have been established that would support the prescription of differential instruction in mathematics for early adolescents according to cognitive style. Nevertheless, the area of cognitive style has been productive of research hypotheses, and investigations more specifically targeted to early adolescent mathematics education may generate results of importance to classroom instruction.

Attitudes toward mathematics. This literature is reviewed in detail by Aiken (1976). The work of Callahan (1971) and Taylor (1970) point out how critical the middle/junior high school years are in the development of attitudes toward mathematics. It appears that at this age level, attitudes toward mathematics, and mathematics achievement, are significantly related to a variety of personality variables that reflect "good adjustment" (Naylor and Gaudry, 1973;

Swafford, 1970). These personality characteristics include a high sense of personal worth, a greater sense of responsibility, and high achievement motivation. Aiken (1972) states that children who have a positive attitude toward mathematics like detailed work, see themselves as more persevering, and are more self-confident than others. At the junior high school level there are often differences between the sexes in mathematics attitude and achievement. Boys like mathematics more than girls do and have higher achievement scores (Hilton and Berglund, 1974; Keeves, 1973; Simpson, 1974). Szetela (1973) reported that mathematics test anxiety is higher for eighth grade girls than for eighth grade boys. Ross (1964) conducted a case study of twenty sixth and seventh grade students, and concluded that variables in the affective domain were critical to the understanding of underachievement in mathematics. The research on attitudes toward mathematics at the junior high level suggests that girls are quite uncomfortable in these classes. Research on ways to reduce this anxiety and encourage constructive involvement seems especially important.

Implications of Early Adolescent Mathematics Research

- Research based on the Piagetian model clearly indicates that many early adolescents are not at the formal operational level. Existing curricula should be examined to determine the extent of their reliance on formal operations in the Piagetian sense, and either supplementary instructional materials or new curricula may need to be devised.

- Most research studies involving early adolescents have focused on only one grade level. Comprehensive investigations of the entire middle/junior high school period are called for.

- A major goal of early adolescent mathematics instruction is the development of critical thinking. Practice in the application of logic and proof procedures to non-mathematical content may facilitate transfer, and should be further researched.

- Significant sex differences in attitudes toward mathematics emerge during early adolescence. The middle/junior high school years appear to be a critical period for intervention if "mathematics anxiety" and lower achievement scores among females are to be countered.

Current Social Science Instruction for Early Adolescents

Few courses designated specifically as "social science" are offered at the middle/junior high school level. However, social studies courses of various kinds are offered almost universally, and their content is frequently drawn from the social sciences. Wiley and Race (1977) provide information on typical course offerings during the early adolescent period. In the fifth grade, some time is generally devoted to United States history. Courses in the Western Hemisphere or World Cultures are taught at the sixth grade level. The seventh grade curriculum is somewhat more variable, and may offer the greatest opportunity for the incorporation of true social science content. Based on analysis of curriculum guides, Wiley and Race conclude that over the past twenty years there has been a shift away from regional studies in the seventh grade toward the study of broader themes, such as gaps between rich and poor nations, or national independence movements. There is less heterogeneity in the eighth grade, where, once again, United States history is typically covered. In grade nine and into senior high

school, specialized courses more closely related to the individual disciplines of the social sciences may be found.

The RTI (1977) survey of current practices in science, mathematics, and social science instruction indicated that at grades seven to nine an average of thirty-nine minutes per school day is devoted to social studies. Of that time, an average of fifty-one percent is spent in whole-class instruction, thirty-five percent in individual work, and fourteen percent in small group work. Discussion is reported to be the predominant mode of instruction, occurring at least once a week in ninety percent of grade seven to nine social studies classes. Lecture, tests or quizzes, and individual assignments are used somewhat less frequently.

In responding to an RTI survey question on problems in social studies instruction, forty-eight percent of grade seven to nine social studies teachers reported inadequate student reading abilities as a serious problem. This general concern with student reading ability may reflect heavy reliance on textbooks in social studies instruction. Lack of materials for individualizing instruction was cited as serious by thirty-two percent, insufficient funds for equipment and supplies by twenty-five percent, and too large classes by twenty-two percent.

Instructional Research in Social Science

There is a large research literature on social studies instruction, and a significant number of investigations have involved children in early adolescence. Unfortunately, due to the diffuse nature of curricular "treatments" in this subject area and due to methodological flaws in numerous studies, much of this literature is of little value in trying to formulate general conclusions. As a result, while an attempt has been made to confine the research touched upon in this section to the early adolescent period, a few important studies using older or younger children are also included.

Wiley and Race (1977) have noted that the research in social studies instruction is difficult to synthesize. Most reviews turn out to be little more than annotated bibliographies. One extensive, recent review which succeeded in drawing conclusions across studies and adducing implications was that of Hunkins et al (1977). The chapters of their review authored by Martorella and by Ehman served as a basis for the following summary of research pertaining to social science/social studies for early adolescents.

Concept learning in early adolescent social science. One recent study relating concrete versus formal operations to social science instruction was that of Meinke et al (1975), who studied the learning of "concrete thinkers" versus "abstract thinkers" at the fourth, sixth, and eighth grade levels. The dependent variable measured learning of the concepts freedom, justice, nonfreedom, and nonjustice. Not only did performance improve with age, but abstract thinkers outperformed concrete thinkers, significantly. This result suggests careful attention to the ability to learn complex social science concepts among children at different levels of cognitive development. Findings of this kind might be interpreted in the light of Adelson's (1975) developmental schema for political thought, presented in Part I.

Martorella observes that work on concept learning in social science instruction has been hampered by the general ambiguity and lack of consensus in the use of the term concept. He indicates that there are at least five common usages. This observation suggests that greater attention to the organization of social science content, i.e. the formal structure of the material, may be desirable. It should be noted, however, that curricula, employing a more explicit formal structure and presenting concepts more systematically were developed in

the late 1960's (the "new social studies"), but were never widely adopted. If social science curricula are to be improved by the introduction of more formal content of schemata, attention must be given to issues of overall difficulty of the material for students, of teacher preparation, and teacher acceptance of more rigorous course content.

Studies of instructional methods. Additional data suggesting a lack of clarity in precisely identifying the facts, principles, relationships, and other elements of social science content are provided by studies of mastery learning. Six studies of mastery learning approaches in social studies instruction were reviewed by Martorella, two of which (Fagen, 1976; Wyckoff, 1974) used early adolescents at the sixth or seventh grade levels. Results of the six studies were in general not significant. Perhaps due to the nature of social studies/social science content, learning hierarchies may be hard to define in this subject matter area. Thus, mastery learning may be difficult to implement.

Other studies of specific methods in the area of early adolescent social science have explored the use of behavioral objectives, especially the strategy of informing students of exactly what they are to learn prior to instruction, and the use of advance organizers. Of the six studies on behavioral objectives reviewed by Martorella, none involved children below the tenth grade level, but marginally positive findings suggest that research at the early adolescent level might prove fruitful. Research on advance organizers suffers from poor delineation of the instructional treatment applied. Of the studies reviewed by Martorella in this area, only one (Allen, 1970) used early adolescents. Allen studied the use of memory versus higher-order questioning and presence versus absence of advance organizers to produce four distinct treatments. Twelve classes of ninth grade students were taught from lessons in Asian studies using one of the four methods. The use of advance organizers showed scattered positive effects. Classes taught using memory questions were superior on a memory post-test, while those taught using higher-order questioning showed superior performance on a post-test with higher-order questions. Similar results on questioning were obtained by Hunkins (1968) using sixth grade pupils.

Research on general instructional approaches, e.g. discovery learning versus expository teaching methods, has led to no clear conclusions. The bulk of this research appears to have been carried out using either elementary school children or students in the tenth grade or above, but some research has employed early adolescents. Studies comparing different nonexpository approaches in the teaching of sociology material to seventh grade students have yielded conflicting results (Boedecker, 1971; Beery, 1972). Armstrong (1970) conducted a similar investigation of eighth grade social science instruction, and found no significant differences among treatments in standardized achievement test performance, but did report differences on a test of "critical thinking."

Evaluation of entire curricula. Possible reasons for the general lack of conclusive findings in the research on early adolescent social science instructional methods include a general lack of precision in describing instructional treatments and the brief duration of many experimentally induced treatments. In the light of these problems, the comparison of entire curricular programs over an extended period of instruction is a promising approach. Unfortunately, instruction for the control group to which a new curriculum is compared typically is not described. An additional problem in curriculum evaluation is the selection of student outcome measures that are fair to all groups compared. An instrument keyed specifically to the stated objectives of any given curriculum is likely to present that curriculum in a favorable light relative to others.

Three curriculum evaluations of early adolescent social science instruction

were identified. The first of these, by Tredwell and Zodikoff (1974), contrasted a fifth-grade group using Man: A Course of Study (MACOS) to a group receiving traditional instruction. After a year of instruction, no significant difference was found between the two groups, using the social studies section of the Metropolitan Achievement Test. A similar finding was reported by Court and Peskowitz (1977), who also found no achievement differences between groups of early adolescents taught using MACOS and traditional materials. In the third study, Engle et al (1972) found that on a test designed to correlate with the objectives of the course, American Political Behavior, eighth, ninth, and twelfth grade classes using that course outperformed other classes. On measures of political skills, however, mixed results were reported.

The recent work of Eisner (1977) on educational evaluation may provide a more generous conception of evaluation, particularly applicable to social science/social studies content. Eisner describes two concepts, educational connoisseurship and educational criticism, which yield procedures complementing scientific approaches to evaluation, which are currently used.

Research on specific instructional techniques. An active area of research at both the elementary and junior high school level has been the use of specific instructional techniques. In this section, a number of such studies dealing with fifth to ninth grade children are touched upon. Wilson (1972) found no significant differences among peer tutoring, small group discussion, and independent study in teaching geography. Clifford (1975) found that among fifth and sixth graders, direct teacher assignments were superior to providing students a range of study alternatives for teaching social science vocabulary. Simulation games result in better retention of geography facts than programmed instruction at the fifth grade level (Keach and Pierfy, 1972).

Research on value analysis and value clarification techniques. Substantial research in these areas has been conducted since 1973 (Ehman, 1977). Ehman reviews eight studies of value clarification and/or value analysis, of which seven were conducted using children in grades five to nine. The conclusion reached in the review is that research in this area offers little basis for generalization, except that these techniques tend to have a positive influence on student self-concept.

The inculcation of political ideals through social science instruction. Torney et al (1975) reported a major study of civics education in ten countries. Over 30,000 students ages ten, fourteen, and "pre-university" responded to questionnaires. Findings of this study and other smaller surveys "cast doubt on the development through the school years of support for democratic values, and tend to show that political knowledge does not lead to these values...The number of social studies courses taken by students has little or no relationship to political attitudes of students" (Ehman, 1977, pp.88-89).

Implications of Early Adolescent Social Science Research

- Few courses designated specifically as "social science" are offered at the middle/junior high school level.

- Consideration is required of the purposes of social studies or social science instruction for early adolescents. Curriculum content and organization should be developed which reflect these considerations.

- Most research studies involving early adolescents have focused on only one grade level. Comprehensive investigations of the entire middle/junior high school grade range are called for.

- Little research relating early adolescent cognitive development to ability to master social science content has appeared. Research that isolates abilities required for social science instruction is needed. Such research might draw upon the kinds of abilities identified by developmental psychologists.

- Diversity in level of cognitive development may have implications for social science instruction. If formal thinkers can master such abstract concepts as freedom or justice, while concrete thinkers cannot, differential instruction might be indicated.

Group Differences in Early Adolescent Science, Mathematics, and Social Science Course Taking and Achievement

This section reports research concerning group differences in early adolescent course taking and science achievement. In the first section, research on sex differences in cognition and social cognition is summarized. This provides a background for the second section in which a summary of science achievement patterns among the nation's thirteen year olds, as reported in a recent national survey (National Center for Education Statistics, 1978), is given. The third section presents differential patterns of science and mathematics course taking for males versus females and for selected racial/ethnic groups. The final section presents research conducted on older students (eleventh grade) and discusses group differences in scientific career development.

Research on Sex Differences in Cognition and Social Cognition During Early Adolescence

Using the Maccoby and Jacklin (1974) review of sex differences, several findings relevant to the period of early adolescence were noted. The authors point out that they do not offer clear-cut evidence as to the extent of differences between the sexes on any of the measured traits and there is generally a large overlap between the distributions of scores for the two sexes. Relevant findings were as follows: (1) Females test higher in general intelligence during the preschool years, and males test higher during high school. After age ten, sex differences are minimal in the verbal ability domain, except that females do better in grammar, spelling, and word fluency. (2) In number ability, no sex differences appear in the early years, but by high school age, males do better at "arithmetical reasoning." (3) Males consistently excel from early grade school on through high school on tests of spatial ability. (4) Sex differences in analytic abilities are less clear. However, from around age six males seem to do better at this cluster of traits. (5) When problem-solving involves the manipulation of objects and trying a range of approaches males will do better. (6) Females get better grades at all levels of education, even in subjects on which males excel on standardized achievement tests. A critique of Maccoby and Jacklin by Block (1976) points out that as age increases, there are often increasing sex differences in many domains of behavior both cognitive and affective. Block states that their review, though thorough, did not carefully consider the ages of the children in drawing their conclusions. It is suggested that a number of sex differences which emerge at early adolescence were masked by the inclusion of a large number of studies using young children.

McGuinness and Pribram (1977) consider psychobiological factors in the development of cognitive differences between the sexes. They review data on sex differences in sensory, motor, attentional, and cognitive tasks, and summarize their review by describing the female as more communicative, with a bias toward fine-motor aptitude, and the male as more "object" or manipulation oriented with a bias toward gross-motor activities. The authors hypothesize that early sensory-motor differences between the sexes, which interact with brain control mechanisms, give rise to the development of differences in cognitive abilities.

Hill and Palmquist (1978) state that sex differences in the area of social cognition are not clear cut. Maccoby and Jacklin (1974) indicate that only two findings were well documented: (1) Males are more aggressive than females. Furthermore, aggressiveness appears more apt to inhibit intellectual development in males and facilitate it in females. (2) Males are more likely to accept an intellectual challenge and females to turn away from one. This finding occurs most

often at the onset of early adolescence and may be associated with perceptions of the adult female role.

Patterns of Science Achievement

As part of the National Assessment of Educational Progress (NAEP), the science achievement of a representative sample of thirteen year olds was recently surveyed (National Center for Education Statistics, 1978). Equally recent data in mathematics and social science were not available, hence only patterns of achievement in science will be reviewed. Knowledge of fundamental facts and principles in the physical and biological sciences, as well as applications of these fundamentals in a range of problem situations, were assessed. Reported data only permitted contrasting the performance of males and females, of youth in different geographic regions and types of communities, of youth whose parents had completed different amounts of schooling, and of white versus black thirteen year olds.

When the performance of thirteen year olds in 1977 is contrasted with thirteen year old performance in 1970 and in 1973, it appears that the earlier downward trend in science achievement is lessening. While physical science achievement declined between 1973 and 1977 (continuing the pattern from 1970 to 1973), achievement in biology appears to have stabilized.

Certain groups of thirteen year olds showed above average performance, while the performance of other groups was consistently below average. Some specific findings were as follows:

- Average science achievement is higher for males students than female students.
- Average science achievement is highest in the Northeastern and Central regions of the nation and lowest in the Southeast.
- Average science achievement is higher for white students than for black students.
- Science achievement is positively related to parental education.
- Science achievement is highest in advantaged-urban communities and suburbs of big cities. Science achievement is lowest in disadvantaged-urban communities and in big cities.

In putting these results into perspective, it should be noted that findings were to some extent determined by the choice of groups for which results were reported. For example, if comparisons were made specifically between middle-class students in different racial/ethnic groups, no group differences might be found. If data on thirteen year olds had been classified in different ways, additional patterns would have emerged.

Early Adolescent Course Taking in Science and Mathematics and Later Opportunity

In senior high school, many students fail to take mathematics and science electives. Helgeson et al (1977) report that after grade ten, about half of all students take no more science. The decision against advanced mathematics and science sequences necessarily closes many doors, to some careers in business, agriculture, and other areas as well as in mathematics and science.

Once students enter senior high school, it may be too late to influence decisions concerning science and mathematics course taking, as suggested by the failure of career intervention attempts at the ninth and twelfth grade levels (personal communications from Dale J. Prediger, cited in Fox, 1977). Fox (1977,

p.3) suggests that for some students the decision to leave mathematics course sequences may occur as early as the seventh grade, when eighth grade algebra becomes optional. She further reports that many female students may elect not to continue in mathematics because they do not perceive the usefulness of advanced mathematics courses to their plans for further education and for careers. Another explanation for the avoidance of mathematics courses, especially by women, is "math anxiety." Fox (1977, p.30) states: "Anecdotal accounts suggest that the onset of anxiety can occur as early as third grade and as late as graduate school levels. It is logical to suppose that the early adolescent years are particularly critical, as that is the time when sex differences seem to begin to be found on tests and the point at which mathematics becomes more abstract." These arguments clearly indicate that middle/junior high school students must be educated to the importance of continued coursework in science and mathematics. Given negative societal stereotypes concerning the academic performance of women and minorities, such emphasis may be especially crucial for these groups during the early adolescent years.

Wiley and Harnischfeger (1977) have noted that in the two years from 1970/71 to 1972/73, as secondary school mathematics enrollments declined, "Total general science course taking in secondary school declined by thirteen percent and, within the highest, senior high school grades, even more so, amounting to thirty percent. College preparatory science has also declined: biology by one percent, chemistry, ten percent, and physics, thirty percent, the decline magnitude depending on the mathematical preparation required" (p.210, italics added). It may be that, once students have elected against further mathematics coursework, continued science coursework is unlikely. Possibly middle/junior high school teachers and counselors discourage students who lack mathematical preparation from taking advanced science courses because they equate science to computation.

Sells (1976) asserts that algebra and geometry courses act as "filters" which keep many students out of standard physics and chemistry courses in the high school. She presents evidence that substantially fewer women and minorities than white males graduate from high school with the mathematical prerequisites for college majors in such science-related areas as the agricultural sciences, chemistry, engineering, or the physical and biological sciences. Sells reports that among 1976 enrolling college freshmen at the University of Maryland, an average of seventy percent of the men but only forty-seven percent of the women had had four or more years of high school mathematics, the means being 3.77 years for men and 3.40 years for women. Among blacks, only fifty percent of the men and thirty-five percent of the women had taken four years of mathematics in high school, the means being 3.44 and 3.16 years, respectively.

Fennema (1977) reports data on high school mathematics course enrollments in the State of Wisconsin during the 1975/76 school year which show a similar pattern. While enrollments of males and females in algebra and geometry are essentially equivalent, enrollments in algebra II, pre-calculus, trigonometry, analytic geometry, probability/statistics, computer mathematics, and calculus are all substantially higher for males than for females. In total, forty-four percent more males than females were enrolled in these advanced courses.

Whatever the reasons for not continuing in mathematics, the negative consequences of the mathematics avoidance patterns suggested by these data are clear. In an article on women in science, Strauss (1978, p.182) writes: "The lower ability and interest in mathematics of most young girls becomes apparent in the junior high school years, when more girls than boys begin to avoid the challenging mathematics electives. This leads to a barrier to women's participation in science--the 'mathematics filter.'...Since so many young women fail to enroll in mathematics courses in high school, they do not acquire important skills necessary for

later training in technical fields. Young women also tend to avoid courses that entail the use of mathematics, such as chemistry and physics. With the present reliance on computer technology, skill in the application of mathematics contributes to career success in social science, business, management, and education. Accordingly, bright young women with the interest and potential for attaining a graduate degree in any field, other than the arts and humanities, should take a mathematics sequence through calculus."

Research on Group Differences in Scientific Career Development

The American Institutes for Research (AIR) recently completed a study that investigated scientific career development. Their results revealed that three times as many female high school students were aspiring toward science careers in 1975 as in 1960. Using the 1960 Project Talent sample of eleventh graders, thirty-two percent of the males and five percent of the females were planning science careers. In the 1975 sample, twenty-four percent of the males and seventeen percent of the females had science career plans (Gilmartin, et al, 1976).

In 1975, differences in aspirations toward science careers were also evident between various ethnic/racial groups: fourteen percent of the blacks, fifteen percent of the Spanish surname students, twenty-three percent of the whites, and twenty-nine percent of the Orientals planned science careers. These findings show that while significant gaps in science career aspirations remain, some progress has been made over the past two decades.

In general, eleventh grade students were found to have information about their own academic attainments, interests, and values, as well as the characteristics of people in a variety of science occupations. They were also aware of the educational requirements and salaries in various occupations. However, there were several deficits in information that could reduce the likelihood of their establishing a career in science. Few differences were found between males and females in self-perception and perception of careers. However, black and Spanish surnamed students were less accurate than others in judging their academic attainments, interests, and values relative to those of other students and were also less accurate in judging the characteristics of workers in selected science occupations.

AIR developed a composite measure made up of differentially weighted subtest scores collected as part of Project Talent which best discriminated between individuals in science versus non-science jobs eleven years after high school. Using the eleventh grade 1975 sample there were no differences in the average composite score between males and females. This indicated, according to AIR, that the lower representation of women in science careers is not the result of differential development before and during high school. However, large differences on the composit score were found among the four major ethnic groups with blacks and Spanish surname students scoring one standard deviation below whites and Orientals. AIR interprets this finding to mean that the factors which lead to underrepresentation of minorities in science are largely present before high school age, i.e. before and during early adolescence.

Implications

- Sex and race stereotyping, "math anxiety", and lack of awareness of the importance of mathematics lead many students to avoid necessary courses beginning with algebra in the eighth or ninth grade. This problem is especially acute among women and minorities.

- Students who avoid high school mathematics sequences typically do not have

the mathematical skills required for high school science courses such as chemistry and physics. Such avoidance often begins in early adolescence. More students might be encouraged to take such courses if development of necessary mathematics skills were incorporated into course content.

- Science and mathematics courses beyond the middle/junior high school level are necessary for many careers and for a high level of science literacy.

- Early adolescents and their parents need to be alerted to the importance of science and mathematics course taking at the middle/junior high school level.

Curricula and Instructional Systems for Early Adolescent Science, Mathematics, and Social Science Instruction

The first part of this section presents summary data on the number of curriculum projects which to some degree impinge on early adolescent instruction. In the second part of the section, curriculum and/or instructional systems in the areas of science, mathematics, and social science for early adolescents are reviewed. These reviews of representative materials suggest the range of content and variety of methods and instructional philosophies presently available.

Availability of Science, Mathematics, and Social Science Curricula

Only a few illustrative curricula are reviewed in this document. An exhaustive review was not feasible, as the number of curricula or curriculum components suitable for use with early adolescents is too large, and their contents and methods are diverse. Even a review restricted to science, mathematics, and social science materials for the middle/junior high school only could include over sixty-five products. Furthermore, most of the available materials for use with early adolescents are embedded in series that extend downward into the elementary school years, and/or upward into senior high school. When these products as well as those solely for early adolescents are considered, over 300 are represented. Compendia of detailed reviews of curriculum projects in these areas are available. The interested reader is referred to the International Clearinghouse document, Twenty Years of Science and Mathematics Curriculum Development: The Tenth Report, edited by J. David Lockard (1977), and earlier reports in the same series. For curriculum projects recently funded by the National Science Foundation, the reader is referred to Development Projects in Science Education (National Science Foundation, 1977). Additional information is also contained in the booklet, Course and Curriculum Improvement Projects: Mathematics, Science, Social Studies (National Science Foundation, 1974). It is important to note that not all of these products represent complete curriculum packages. Many are isolated materials not integrated into comprehensive instructional packages. The number of comprehensive curricula for use at this age level is small.

The following summary statistics are based on tabulations of partial or complete curricula and/or materials cited in the Lockard (1977) report. Sixty-six programs or products specifically for the middle/junior high school (some portion of the period from grade five through grade nine) were listed. An additional eighty-nine programs or products for younger children overlapped with this period, eighty-two programs or products for older children extended downward into this period, and eighty-three included the entire middle/junior high school range along with both older and younger children. Most of this last category were K through twelve series. These figures clearly indicate that the middle/junior high school has received less attention than the traditional elementary and secondary levels. Of the sixty-six middle/junior high school materials, fifteen were in mathematics, thirty-five were in science, two were social studies programs, six dealt with environmental education, and the remaining eight were coded as including more than one of these areas. The relative scarcity of social studies curricula should be noted. Among those including older or younger children as well as pupils in grades five through nine, only eight of the 320 programs or products dealt exclusively with social studies context. This unequal coverage may reflect only the intended scope of the reivew, not the state of early adolescent social studies materials. It is likely, however, that if significant numbers of early adolescent social science curricula were available, they would have appeared in the Lockard (1977) report.

A comprehensive document has been produced each year since 1973 by the Interagency Panel for Research and Development on Adolescence. These documents provide an annual summary of information on federal research on adolescence. Unfortunately, adolescence is defined for purposes of the interagency reports as the period from age ten to age twenty-four. Since detailed data are not provided on the targeting of research and development efforts within this broad age range, no summary specific to the early adolescent period could be abstracted. Roughly 3,000 adolescence projects were funded in FY 76 (Social Research Group, 1977). Most research and development activity for this period was channeled through institutions involved in education. Fifty-four percent of the projects involved some form of educational curriculum, over 450 in mathematics. Roughly 300 included social studies context, and roughly 180 included some science. These figures indicate extensive concern and involvement of federal agencies in adolescence as broadly defined, but a similar summary of research and development activities specifically for early adolescents is not available.

Implications

- Relatively few available curricula in science, mathematics, and social science are focused specifically on the period of early adolescence. Rather this age span is often covered at the end of an elementary curriculum series or at the beginning of a secondary series.

- Information on the scope, suitability, and effectiveness of existing curricula should be compiled before additional curriculum development is undertaken.

Examples of Middle/Junior High School Curricula and Instructional Systems in Science, Mathematics, and Social Science

In this section several middle/junior high school curricula and instructional systems are reviewed to give some indication of the range of programs available. In the natural sciences, the Intermediate Science Curriculum Study (ISCS), the Human Sciences Program (HSP) and Project City Science are reviewed. In the area of mathematics two projects are described, the Mathematics Resource Project and The University of Illinois Committee on School Mathematics (UICSM) Motion Geometry curriculum. In the area of social science the two projects reviewed are Citizenship for Decision-making and The Indiana Elementary School Teachers Geography Project.

Intermediate Science Curriculum Study (ISCS)

ISCS is an interdisciplinary science program for use at the middle/junior high school level, typically grades seven to nine. It was developed at Florida State University and supported by grants from the National Science Foundation and the U.S. Office of Education. The following description of the philosophy, methods, and content of ISCS are based upon material presented in the Teacher's Editions of the student texts (ISCS, 1972).

ISCS is founded on the belief that junior high school science should aim primarily to develop in students an understanding of the nature and process of science, and only secondarily to prepare them for future science courses or for specific vocations. Neither the processes nor the concepts of science are developed independently. Rather, processes and concepts are introduced simultaneously

as student investigation leads to development of major concepts. In recognition of the diverse interests and abilities of early adolescents, ISCS provides for individuals to progress at different rates, and to select certain activities of their own choosing. Finally, it is the philosophy of the ISCS developers that early adolescents profit more from hands-on experience than textbook-bound instruction. The ISCS approach is activity-centered, and premature formalization of concepts is avoided.

The instructional method employed in the ISCS program is one of directed experimentation. Materials and equipment are accessible to students, and they follow written instructions to get out the equipment required and carry out specified experiments, either individually or in small groups. Instructions are accompanied by detailed illustrations, and at strategic points ("checkups") the instructors ask questions of students to check their understanding of ideas and procedures. During the first two years of the program, all students progress in sequence through the same core activities. For individual students, however, additional activities are inserted to correct deficiencies detected through checkups, and to permit in-depth exploration of topics of special interest.

Each of the first two years of instruction is organized around a learning theme. The first year, Level I, has the theme "Energy, its forms and characteristics." The processes developed at this level are measurement and operational definition. This level involves such activities as measuring force, measuring distance, identifying forms of energy, and observing energy conversion. Early activities are drawn from the content of physics, and later activities from that of chemistry. In the second year, Level II, the theme is "Matter, its composition and behavior," and the process is model building. Activities involve observing and inferring, e.g. inferring that there are a "limited number of particles called atoms." Early Level II activities are drawn primarily from the content of chemistry, but by the end of Level II applications are made to biological systems. The content of the third year (Level III) curriculum is a set of independent units, including astronomy, biology, geology, human variation, genetics, space science, and meteorology, among others. These are used to teach the processes of experimentation and investigation.

In summary, ISCS is designed to introduce junior high school students to, and provide experiences with, "the techniques whereby scientists gain information about nature." The developers of ISCS believe that in our scientific society, such understandings are important to all citizens.

Human Sciences Program (HSP)

The purpose of this program is to make available a set of curriculum materials for early adolescents with content drawn largely from the biological and behavioral sciences. This three year project has been supported by the National Science Foundation.

HSP seeks to facilitate the movement of youth from childhood to adolescence. The program developers recognize the immense diversity in the physical, cognitive, and affective development of early adolescents. Therefore, choice and flexibility are salient attributes of the program. The HSP curriculum accomodates diversity by providing a variety of learning activities related to any given topic. Students may choose among these activities, which increases student motivation to learn.

The organization of the HSP is modular. Each module includes a range of related activities, but distinct modules are relatively independent and can be sequenced to suit local requirements and preferences. Modules are grouped into three broad levels of difficulty, with those at each level suitable for a one year

course of study. At Level I, suitable for use with eleven to twelve year olds, modules are included on topics such as Learning, Sense of Nonsense?, and Growing. Examples of Level II modules, suitable for use with older students, are Perception, Rules, and Reproduction. At the highest level of difficulty, Level III, such themes as Knowing, Invention, and Feeling Fit are included. In all, there are fifteen modules, which have been tested in a wide range of classroom settings throughout the nation. HSP materials have also been reviewed by parent panels for acceptability, panels of natural and social scientists for content accuracy, and psychologists for suitability as to development level.

Since HSP stresses individualized learning, there is a well worked out personalized testing and evaluation component. Students are involved in self-evaluation, as well as essay and objective testing associated with each module. The evaluation scheme requires students to demonstrate not only the possession of science information but applications of such information in problem situations.

The role of the teacher in HSP is more as a consultant, a cooperative worker, and resource person. The teacher encourages students towards autonomy in learning.

Each topic in HSP is introduced with a concrete, hands-on activity, which may involve direct observation, experimentation or manipulation (Hurd, 1978). Hurd describes the purpose of these introductory tasks as providing a focus for attention, guiding the learning task, and providing information for concept formation.

Following this introductory task, students engage in a cluster of several different but related activities, expanding upon the concept being developed. Most of these activities tie into other, related concepts, or lead to a decision or action. Through a continuing interplay of experience and abstraction and an alternation of inquiry and decision-making, students are shown the relevance and significance of the HSP curriculum content.

The HSP is distinctive in its explicit concern with decision-making skills. The curriculum seeks to provide emerging adolescents with opportunities to resolve problems and determine responsible actions through the application of relevant, reliable knowledge. The contexts in which these skills are developed include problems of the environment, of survival, and of change and technology. Science/social dilemmas are used to stimulate discussion, and lead students to apply what they have learned in coming to grips with significant biosocial issues.

Hurd (1978, p.37-38) has stated:

> The primary objective of HSP is to emphasize the processes and conditions that influence the way knowledge is interpreted in the context of real problems and issues rather than to focus on specific values that may emerge from learning activities. There is the hope that, on one hand, students will develop an awareness that no important human problems are likely to be resolved without a consideration of values, and, on the other hand, they will become aware that relevant and reliable knowledge is essential for rational action.

Project City Science (PCS)

Project City Science (PCS) is a comprehensive program to improve middle/junior high school science instruction, especially in the inner city. It is based at New York University, and was first funded in 1974 by the National Science Foundation. Project activities are directed toward four major programs: a preservice program, a model districts program, a research and evaluation program, and a dissemination program (PCS, undated).

The preservice program is a year-long program for graduate students working toward a Master of Arts in science education. This program was designed in response to an acute need for science teachers trained specifically to work with inner city youth in grades six through nine. The program incorporates extensive field experience as well as coursework. Methods and curricula for inner city early adolescents are studied, as are the psychology and sociology of this student population. In all preservice activities, the context of early adolescent education, both in and out of the classroom, is recognized. This recognition promotes an awareness and consequent participation in community activities. One important feature of the preservice program is participation in workshops in areas such as reading problems, bilingualism, and group dynamics. The PCS preservice program is closely linked to the model districts program given that it trains intermediate level science teachers who are participating in the projects' two model districts.

The primary emphasis of the model districts program is to develop districts which are models of exemplary science teaching. In addition, the model districts program helps foster the strong partnership between the university, the schools, and the community. Focused in two New York City school districts, this program has involved the Board of Education, the United Federation of Teachers, and community agencies, as well as teachers and administrative school personnel. One goal of the model districts program has been to develop innovative instructional activities and strategies in response to cutbacks in staff, and in budget for equipment and supplies. In each of the participating schools, teams are composed of: a doctoral student in science education, who serves as an on site coordinator for the project; a preservice intern; and a cooperating teacher. The project on-site coordinator acts as a change agent, striving to develop strong working relationships with school personnel. The coordinator encourages teachers to utilize hands-on activities and constantly to reassess their teaching. In addition, the coordinator helps the preservice intern with such things as lesson planning, test construction, and the improvement of teaching methodology. The team approach emphasizes project accessability, responsiveness, and encouragement of frequent communication among team members. To facilitate the team's work in the schools, some members of the project staff meet periodically with district and school administrative personnel. Project staff members assume both collaborative and advisory roles as they become sensitized to district and school needs in order to improve science education. In summary, the model districts component of PCS in combination with the preservice component works to produce strong university/school/community relationships, as well as to encourage exemplary middle/junior high school science teaching in the inner city.

To complement PCS's strong commitment to demonstrating practical improvement in inner city science education, plans for a research institute have been developed. At present, the research institute would continue for a minimum of fifteen years at New York University. Its goal would be to generate systematic knowledge relating to the science education on inner city youth. In the summer of 1977, the PCS research program was formalized and the following seven areas of research interest were identified (PCS, 1977, pp.32-33):

-- Science Knowledge Among Inner City Early Adolescents

-- Science Attitudes Among Inner City Early Adolescents

-- Science Learning Among Inner City Early Adolescents

-- The Science Teacher-Science Student Interaction in Inner City Intermediate Schools

-- Nonteacher Influences on the Quality of Science Attitude Formation Among Inner City Early Adolescents

-- Evaluation of the Project City Science Preservice Program

-- Evaluation of the Project City Science Model District Program

During 1977, the research was focused on internal evaluation of the preservice and model districts programs. Both quantitative, objective, and more clinical, descriptive methodologies were used. In addition to ongoing internal review, PCS is currently being evaluated by an external agency.

During the current school year, the second phase of the research program will begin. Studies are planned on inner city science learning problems. While earlier studies focused on teachers involved in the preservice program and the model districts, the focus during the current year will change to incorporate research topics dealing with inner city adolescents, namely, science knowledge, attitude toward science, and science learning. In particular, current research is focused on the relation between individual differences among students, instructional modes (hands-on approach), and student learning of science, attitudes toward science, and interest in science careers. In most of this research, measures of individual differences and assigned instructional modes are treated as independent variables used to explain obtained differences in science learning, attitudes, interest, and aspirations.

Methods of disseminating information on project activities have included three major vehicles. First the Progress Reports, which are prepared three times a year and distributed to approximately 120 school and district administrators. Second, citiscience notes, the Project's monthly newsletter which is distributed to approximately 1800 New York City junior high school teachers. Third, the participation of project staff in local and national conventions in order to reach a variety of audiences including university s[illegible]ce educators, teachers, science supervisors, and union personnel. Attendance at conventions establishes a forum for discussion among individuals who share Project interests and goals. As Project City Science nears the end of its funding period increasing attention has been paid to the content and direction of the dissemination program with the intension of educating wide audiences of those concerned with science education about project programs, techniques, and goals. Ultimately, replication of the project cities nationwide will be the hallmark of its success.

The University of Illinois Committee on School Mathematics (UICSM) Motion Geometry Curriculum

Motion Geometry is an innovative geometry curriculum for use at the middle/junior high school level, typically seventh or eighth grade. Development of this course began in 1964, and has been supported by the National Science Foundation. The following description is taken from Phillips and Zwoyer (1969).

This curriculum approaches formal geometry through the use of isometric mappings, represented by "slides", "flips", and "turns" of tracings students make themselves. After establishing the basic concept of congruence, these three kinds of motions are distinguished and utilized to develop such ideas as parallelism, perpendicularity, symmetry properties and other important geometry concepts. For example, parallelism is indicated when there is a "slide" with no "turn" which moves one line into another. While students engage in deductive reasoning in Motion Geometry, the emphasis is on developing concepts and information which may be organized deductively in later coursework, e.g. at the tenth grade level. Since this curriculum includes only geometry, it would typically be supplemented by some materials in arithmetic, to keep computational skills fresh. The UICSM Stretchers and Shrinkers curriculum (Braunfeld, 1969) or similar materials might

be employed.

Motion Geometry is divided into four books, as follows:

Book 1: Slides, Flips, and Turns
Book 2: Congruence
Book 3: Symmetry
Book 4: Similarity and Area

Major topics covered are tracing, congruence, and the three basic motions (Book 1), lines, rays, segments, and different kinds of angles (Book 2), the classification and properties of different kinds of figures (Book 3), and area, similarity, and geometric constructions (Book 4). Throughout the course, there is an emphasis on experimentation, including physical manipulation of tracing paper and other devices. Students are encouraged to distinguish what they can deduce using earlier results from what they must learn by experimentation. This approach, in which direct verification using tracings is the final authority, may prove motivating to some youth who are not highly involved in typical classroom situations. A laboratory approach is encouraged in which the teacher is an advisor and a guide. Numerous exercises are provided in the student workbooks, and additional exercises are available in a teacher's Activities Handbook, which accompanies a box of Duplicating Masters. These supplementary materials permit the teacher to tailor the curriculum to the needs of the particular teaching situation.

Middle/junior high school mathematics instruction has often been little more than review of material presented in elementary school, or fragmentary collections of special topics. The Motion Geometry curriculum offers a coherent, systematic course of study, appropriate to the abilities and interests of the early adolescent, which anticipates mathematical content typically presented at the senior high school level. Approaches of this kind, which lay the ground-work for later instruction, might help to reduce later "math anxiety", and encourage more mathematics course taking at more advanced levels.

The Mathematics Resource Project

The Mathematics Resource Project was directed at an audience of middle/junior high school mathematics teachers. It was funded in 1974 for forty-one months by the National Science Foundation, and is described in Development Projects in Science Education (National Science Foundation, 1977). The project was based on the premise that middle/junior high school teachers do not have a strong working knowledge of mathematics, didactics, or available resources for effective mathematics teaching. Furthermore, teachers may have little time to devote to collecting available resources which could add to their knowledge. The purpose of the Project was to provide several collections of resource materials which could be used to supplement their knowledge, and to help them enhance the learning environment of their students.

Five collections of resource materials were developed: (1) Number Sense and Arithmetic Skills; (2) Ratio, Proportion, and Scaling; (3) Geometry and Visualization; (4) Statistics and Information Organization; and (5) Mathematics in Science and Society. Each of the five collections contains three basic types of materials. The first type is substantive information on mathematical content, which can enhance teachers' knowledge and application of the topic. The second type of material is information on didactics, including pertinent data on learning theories, methods for evaluating progress, methods for diagnosing problems by interpreting patterns of mathematical errors, and alternative teaching strategies. The third type of material available in each resource collection is a comprehensive set of

classroom materials. These are designed for skill development and applied problem solving, and also include suggestions for classroom projects. These materials are being made available through Creative Publications in Palo Alto, California.

There is no specific, or fixed, course of study suggested by the project. The resource materials could be used to supplement a textbook, or as a core around which a mathematics program could be developed. The materials could also be used in interdisciplinary curricula which require mathematical problem solving.

The innovative quality of these materials is found in their provision of mathematical and didactical ideas for teachers, combined with classroom materials for students.

The Indiana Elementary School Teachers Training Project in Geography

The Indiana School Teachers Training Project in Geography designed a social science course in geography which was made available to inservice school teachers in grades four through six. Participation in this NSF-sponsored program was limited to teachers from central Indiana. The program presented substantive information on geographic concepts and skills, and applications of this information in the classroom (Backler, Note 1).

This program was responsive to a developing awareness that fourth through sixth grade teachers needed additional training in order to competently teach geographical concepts and skills as outlined in the Indiana State curricular guidelines for elementary social studies.

Project participants were introduced to a variety of geographic concepts and skills. Examples of types of geographical concepts included natural resources, location, interdependence, settlement patterns of immigrants, urbanization, industrialization, and areal associations. Examples of types of skills included mapping skills and spatial hypothesizing. The materials which introduced teachers to these concepts were self-paced assignments. There were a total of ten weekly lessons developed and teachers proceeded through these materials at home. Each lesson required approximately three to four hours to complete. As these lessons were based on a mastery learning approach, teachers received diagnostic progress reports. Progress reports, as well as questions and problems which developed as teachers worked on the materials at home, were handled using a toll-free WATS line to the project center where staff provided one-to-one interaction with teachers.

In addition to introducing teachers to geographic concepts and skills, they were also provided opportunities to develop classroom activities which made use of the concepts and skills. These activities were conducted at monthly sessions, which teachers attended.

Teachers were evaluated on their learning of geography concepts and skills using several objective examinations. Teacher performance in developing geography activities for classroom application was determined by requiring participants to prepare four activities for classroom use. The more effective lessons were identified by project staff, and described in a newsletter available statewide that was distributed to all project participants.

Citizenship Decision-Making: Skill Activities and Materials, Grades 4-9 (CDM)

Citizenship Decision-Making: Skill Activities and Materials is a curriculum directed specifically at the middle/junior high school level. The materials were developed by the Citizenship Development Program at the Mershon Center located at Ohio State University (LaRaus and Remy, 1978). The authors focus on early adolescence as a critical period during which youth undergo a variety of psychological changes, including changes in political conceptualization.

The purpose of the curriculum is to provide an experience-based approach to citizenship. That is to say, citizenship is not treated as an abstract concept in the social sciences, but rather as a phenomenon which is part of the day-to-day experience of all individuals. CDM is made up of twenty-five lessons for teachers to use with students. Each lesson can be characterized as a short, self-contained set of instructional activities. It takes about one to three days to complete a lesson with thirty to forty minutes of daily instruction. The twenty-five lessons are divided up into four major units, as follows:

UNIT 1: Decisions and You
UNIT 2: Making Decisions
UNIT 3: Judging Decisions
UNIT 4: Influencing Decisions

There are six key features of the instructional design employed by CDM. First, the curriculum employs an experience based approach to instruction. Decision-making is approached as a phenomenon in which all individuals engage, not as an abstract social science concept. Second, the materials are designed for active learning. Students learn by doing as well as through reading and instruction. In the course of the twenty-five lessons, they are involved in actually making, judging and influencing decisions. A third feature is that the materials employ pattern recognition. Each of the lessons is designed so as to provide cumulative reinforcement of basic skills related to decision-making without being repetitious. Students are provided with a variety of contexts in which they can learn to recognize and employ different decision-making skills. The fourth feature of CDM is the use of experienced based objectives. These are objectives stated in such a way that the objective actually specifies the experience that students will have in the lesson. When students complete the experience they have achieved the objective. Valuing is the fifth key feature of CDM. Values are handled by engaging students in valuing exercises built around Lasswell's eight social values, i.e. affection, enlightenment, power, honesty, respect, skill, wealth, and well-being. In CDM these values are related to the everyday experiences of students. For example, students can easily relate to the experience of power in their daily life. Cultural pluralism and diversity is the sixth key feature. Each lesson is designed to provide a common preparation for all students. Ethnic stereotyping and sexism are avoided by building each lesson around a core of experiences shared by all people. For example, common experiences may include making rules for a group or coping with being "picked on" for judging the decisions of others. Thus, lesson content uses generally universal experiences, which can be elaborated by teachers to suit their students' backgrounds and needs.

The core of the CDM curriculum materials is a book containing several types of information. It begins with an introduction which briefly explains (1) the use of materials for teachers, (2) the instructional design, and (3) how decision-making is treated. This introduction is followed by the twenty-five lessons, each of which is presented using step-by-step teaching instructions followed by blackline masters. In addition there is a glossary of key terms used in the decision-making activities.

The twenty-five lessons are presented following a consistent format. This format contains nine types of information for teacher use. First, the duration of the lesson is indicated. Second, the purpose, or overall goal, of the lesson is given. Third, the objective(s) are stated in terms of specific outcomes of the lesson. Fourth, the materials needed to teach the lesson are listed. Fifth, background information is presented. This is essentially a "mini-course" from

two to eight paragraphs in length on the substantive content of the lesson. Sixth, new vocabulary which will be encountered by students is presented. The seventh section provides teaching strategies for the lesson. These are the core of the lesson. Step-by-step teaching instructions are provided, divided into activities for opening, developing, and concluding the lesson. The eighth type of information presented is referred to as instructional options. These are suggestions for elaborating the lesson through the use of such devices as plays, poetry, and map exercises. The final type of information presented is a set of correlations of the CDM lessons with major reading/literature texts.

Teacher preparation time required for this curriculum is minimal. The authors recognize the multitude of demands placed on teachers, and require only that they read the background material presented with each lesson, make copies of necessary student materials and then follow the step-by-step teaching strategy provided.

Career Education for the Early Adolescent

The Need for Early Adolescent Career Education

Preparation of youth for participation in the world of work is increasingly being recognized as a critical function of the nation's schools. Writers on career education have developed models of career education which span the years from kindergarten into adulthood. These models show how career education can help to develop the values, attitudes, habits, knowledge, and expectations necessary for a satisfying career and lifestyle. At the same time schooling can be focused and enlivened as students see the relevance of what they are learning for their present and future lives. Research on the effectiveness of career education at the middle/junior high school level highlights the usefulness of science, mathematics, and social science courses for all students, not only those destined for careers in the sciences. Students exposed to a fully implemented career education program will learn that science information is of use not only to scientists, but to workers in a broad range of occupations. If students at the middle/junior high school level are to appreciate the future value of "science literacy", such appreciation may best be instilled through career education.

The middle/junior high school years have been identified as a critical period for career education. The early adolescent's interest in self-identity is well documented. One aspect of the quest for identity is exploration into various adult roles (Jordaan, 1963). Evans, Hoyt and Mangum (1973) indicate that career education can contribute directly to this vital process. It promotes exploration of self, society, and one's role in society. These authors conceive vocational maturation as occurring in stages, beginning with an awareness of primary work roles in society and continuing through career exploration, vocational decision-making, and, finally, stages of establishment and maintainance of a primary work role. For these authors, the middle school years are preeminently the period for exploration of work roles. Super (1969) also viewed exploration as more relevant than training during the middle/junior high school years, arguing that specific vocational planning during this time is inappropriate. Osipow (1972) also concluded from his review of career education research that career options should be kept open for middle school youth. Rather than decision-making, he emphasized the importance of work values, habits, and attitudes during the middle school years.

Matheny (1969) argues for a somewhat broader interpretation of the middle/junior high school's role in this area:

> While the middle school has special responsibility for teaching basic habits of industry, it shares with the elementary and senior high school the responsibility for teaching decision-making skills. The middle grades should be a time for self- and occupational exploration, for becoming planning oriented, acquiring decision-making skills, and learning the habits of industry. Except for a few early school leavers, the selection of a specific occupation should be discouraged (pp.18-21).

Gribbons and Lohnes (1968) reported research indicating substantial individual difference variation in career development among students of the same age. Thus, while exploration may be most appropriate for most eighth graders, some eighth grade students are ready to make vocational decisions. In their longitudinal study, early adolescent vocational maturity was related to career aspiration in early adulthood. Their findings would support a broader conceptualization

of career education function at the early adolescent level, in order to meet the diverse needs of different students.

There is substantial evidence that the needs in this area of early adolescents are not being met. In a recent National Institute of Education planning document (NIE, 1977), it was reported that among a sample of high school freshmen, only eighteen percent "had realistic career and educational plans when self-reported interests and abilities were compared with the educational and occupational characteristics of their first career choices." This finding clearly indicates insufficient career exploration in the middle school years. The NIE document later states,

> Junior high school is a silent age in educational innovation. Career education programs...conceptually include activities for junior high school students, as part of K-12 comprehensive programming. However, while career education is shown as beginning during junior high school, few programs involve hands-on, extensive career exploration for students with a focus on planning their high school programs (p.48).

Further support for the lack of career exploration and decision-making at the middle/junior high school level can be found in McLaughlin (1976). In his survey of career education during 1974-5, he reported that traditional activities concerned with the relation of school to work were carried out almost exclusively at the secondary school level. Innovative activities, which tended to be carried out in the earlier grades, were largely confined to the twenty-seven percent of the nation's school districts where formal career education policy statements had been written or were being written. Only three percent of the nation's school districts "had taken [the] steps of obtaining funds, allocating staff, writing a formal policy, forming an Advisory Committee, and carrying out formal evaluations with respect to career education." In the majority of school districts, career education effort had been reported as "now limited."

Another line of research that points to the importance of the early adolescent period for career exploration and the development of attitudes and values is the study of occupational stereotypes. Borow (1966) pointed to the middle school years as the period when the occupational stereotype biases of adult culture are most likely to be acquired. An early study by Simons (1962) of prestige rankings of twenty occupations indicated that by the eighth grade correlations with adult rankings had risen to .94 for both boys and girls. Thus, by the end of the middle school years occupational stereotypes appeared to be well established. Intervention prior to the end of the middle school years is necessary if undesirable stereotyping is to be avoided.

Evans, Hoyt and Mangum (1973) provided twelve points that summarized what research has indicated about career education of early adolescents. Seven relevant points were these:

- These youth are in the process of attaining vocational maturity, but on the whole can best be described as vocationally immature.
- Considerable individual differences in vocational maturity can be expected to be found among middle and junior high school youth. One of the major factors (although not the sole factor) contributing to such differences is parental socio-economic status.
- Middle and junior high school age youth arrive at their schools with occupational stereotypes very similar to those in our culture.

- There is some evidence that the influence of sex stereotyping of occupational plans can be reduced through systematic intervention of career development programs.
- Middle and junior high school age youth arrive at their schools with work values which, in the absence of intervention, are likely to remain remarkably stable through twelfth grade.
- For more than seventy percent of the students specific vocational choices expressed to middle and junior high school people can be expected to change before they reach the twelfth grade.
- The vocational maturity of middle and junior high school students can be enhanced through systematic exposure to the world of occupations, sound counseling and guidance, and experience with work.

The research reviewed above establishes the need for career education programs at the middle/junior high school level. In the next section, evaluations of career education programs are reported.

Evaluations of the Effectiveness of Career Education Programs for Early Adolescents

Enderlein (1976) reviewed a large number of evaluations of career education programs. His review contained a number of evaluations focused directly on children at grade levels five through nine. Only evaluations that focus on these particular grade levels will be reviewed.

Tuckman and Carducci (1975) reviewed thirteen career education evaluation studies. All of these studies attempted to measure the effects of career education upon career awareness. Six of these studies employed samples of children between grades five and nine. Results of these six studies attested to the positive effects of career education on attitudes toward work, occupational information, career maturity, and self-concept at the early adolescent level. All six reported positive benefits for early adolescents involved in career education programs.

Development Associates, Inc. (1975) reviewed forty-five career education projects funded under Part D of the Vocational Education Amendment (Evaluation of Vocational Exemplary Projects, Part D, Vocational Education Act Amendments of 1968). Eight outcome questions were used to summarize findings from these projects. Seven of the eight questions were relevant to early adolescents and are presented in Table 3. Beside each question is a "Yes" or "No" indicating whether there was an overall statistically significant difference favoring career education participants for grade levels six and nine. Results suggest that the younger children were more receptive to the career education programs, again suggesting that intervention during the early adolescent years may be critical.

The Cochise County Career Education Project (Behavioral Research Associates, 1975a) provides information on the effectiveness of career education at the elementary/intermediate level. Although results by specific grade levels were not reported, the results deserve consideration. Two comparison groups were employed in the design, a high exposure to career education group and a low exposure group. Results indicated that the high exposure group had significantly higher scores on all of the dimensions tested. The dimensions were: educational awareness; knowledge of skills required in jobs; knowledge of factors contributing to job satisfaction; common threads in jobs; economic awareness; decision-making; appreciation and attitudes toward work, and knowledge of careers.

Several evaluations have been conducted in the area of career decision-making. Two studies, The Pima County Developmental Career Guidance Project

Table 3

Summary of Conclusions for Outcome Questions Across

Sixth and Ninth Grade Students in Forty-five Career Education Programs

Outcome Question	Sixth Grade	Ninth Grade
Are student participants able to identify a greater number of occupations than non-participants?	Yes	Yes
Do students demonstrate more familiarity with tasks and functions associated with selected occupations than the comparison group?	No	Yes
Are student participants more familiar with the requisitions associated with selected occupations than the comparison group?	Yes	No
Do student participants score higher on prevocational, job readiness tests than the comparison group?	Yes	No
Do student participants indicate more positive attitudes toward employment than non-participants?	Yes	No
Is the variety of careers being considered by individual participating students greater than that of students in the comparison group?	No	No
Do more student participants indicate having a career plan than the comparison group?	-	No

(Behavioral Research Associates, 1975b) and Jacobsen (1975) examined the effectiveness of visits to career centers on improving the decision-making skills of students. Results suggested that as frequency of visits increased, the students' decision-making skills improved.

During the mid 1970's, a number of career education evaluations began to examine the relationship between career education and academic achievement (Enderlein, 1976). One evaluation that sheds some light on this issue was conducted by the Union County Schools in South Carolina (Union County Board of Education, 1975). Twenty elementary, middle and secondary schools participated in the evaluation. Teachers received information on how to infuse career education materials into their instruction. In addition, a career information center was organized and group guidance procedures instituted. Students from grades three, six, and seven were randomly selected to form the experimental and control groups. Comparisons between the experimental and control groups indicated that there were no significant differences in reading or mathematics achievement between the groups at grade three, but at grade six the results were significantly different. The experimental (career education) group scored higher in both areas.

Bryant (1975) compared two matched samples of fifth graders on the Comprehensive Test of Basic Skills. His results indicated that the fifth graders whose teachers infused their language arts and social studies instruction with career education materials performed better than fifth graders receiving ordinary instruction. Bryant reported statistically significant differences between experimental and control groups on each of the following subtests: reading test, language test; study skills test; vocabulary; language expression and reference skills. There were no differences between the experimental and control groups on the mathematics achievement test, which might have resulted from not infusing the mathematics curriculum with career education materials.

Bagley (1975) used the total reading scores, total mathematics score and use of information subtest from the Science Research Associates Achievement Series Form F, to determine the gains of sixth and seventh grade students taught by teachers who had participated in a career education inservice. Control group teachers received no inservice. Analysis of difference scores showed significant differences between the two groups on total reading score only, favoring pupils of inserviced teachers.

In summary, early adolescents who participate in career education programs achieve gains in occupational information, attitudes toward work, career maturity, knowledge of the world of work and are more realistic in their career planning. Where the career education curriculum is infused into academic curriculum it seems to enhance achievement. Also, early adolescents appear to benefit from practicing decision-making through career education.

This brief review is limited in scope and by no means reflects all the evaluation and research on effects of career education on the early adolescent. However, the findings are encouraging and suggest that this age period is receptive to such input. Hoyt (1977) summarized Enderlein's (1976) review and additional reviews by Herr (1977) and New Educational Directions (1977) and concludes that:

- Available evidence more often than not supports career education's worth and effectiveness.
- Only rarely has career education appeared to produce any negative results.
- Generalization concerning the effectiveness of career education programs is difficult due to the wide variability in the programs

which go by this name.

The above evaluations have been concerned with career education as a general program at the middle school level. Career education concepts have been infused into the curriculum in diverse content areas. In the following section, current practices in career education are discussed. Specific references to science, mathematics and social science instruction are included.

Career Education in the Classroom and Beyond

There are numerous career education programs implemented throughout the country. Preli (1978) provides a description of some of the practical techniques which are used in such programs. Some of the techniques used at the early adolescent level include interviews of workers, research using a variety of materials and media, discussions about the world of work, hands-on activities in which students actually try performing the tasks a worker would, field trips, "shadowing" where students spend time observing a model carrying out daily duties on a job, and simulations or role-playing opportunities. Preli (1978) emphasizes the "activity-centered" approach in these techniques. Matheny (1969) has recommended general practices useful at this level, including:

- emphasis in all subjects upon implications for careers
- use of the community as a resource
- real and simulated work experience
- use of career games
- group counseling
- teaching decision-making skills

Preli (1978) and Hoyt (1977) both emphasize the role of community in career education. Community is used broadly to include not only the schools, but also businesses, labor and industrial communities. The integration of currently available resources located in the community is one of the more refreshing qualities of career education--it is not necessary to develop a new "superstructure" in an already complex system. Instead, it is a matter of taking advantage of community resources that presently exist.

In the actual implementation of career education in the middle/junior high school, Evans, Hoyt and Mangum (1973) recommend highlighting distinct concepts at different grade levels, although no concept is taught exclusively at a single grade level. Their recommendations are as follows. For the fifth and sixth grades, work values, awareness and work habits should be emphasized. In grade seven, the world of occupations is highlighted. In grade eight, work values exploration is brought to the fore, and in ninth grade the emphasis is on career decision-making. (If a ninth-grade emphasis on decision-making is likely to lead some early adolescents to conclude that they have no further need for science course-taking, then such decision-making may be premature.) As is clear from this proposal, career education involves much more than the inclusion of job-related information in the curriculum.

Early adolescence, career education and science instruction. The National Science Teachers Association has defined career education as follows:

> Career education is a part of the total education process involving 1) attitudes, 2) thinking and decision-making skills, 3) communicative skills and 4) basic knowledge

that enables the individual to make rational choices about meaningful and satisfying work. (Applied Management Sciences, 1977, p.63)

At the junior high/middle school level, Evans, Hoyt and Mangum (1973) suggest that students be made aware of the concrete "real world" applications of abstract science concepts. The broad range of effects which science has on the student's environment should be treated, and students should see that science knowledge and method are applicable in many walks of life. The content of science courses at the junior high/middle school level not only may be applicable in itself to a broad variety of occupations, but is also prerequisite to advanced science courses in high school and beyond. Failure to take these prerequisite courses may ultimately limit participation in many occupations. In a science-permeated world, courses in general science offer many opportunities to explore such questions as "what am I like?" and "what is my world like?" (Evans, Hoyt and Mangum, 1973).

If the schools are to develop "scientific literacy", science content must be seen as relevant to the practical concerns of all citizens, not just professional scientists. Evans, Hoyt and Mangum (1973) state that an interdisciplinary approach to the content of science, mathematics, social science and other areas can offer the student "both the depth of specialized knowledge and the breadth of 'real world' interrelationships." Thus, career education, by stressing the relevance of science to the range of the student's experiences in and out of school, offers a potential base for the development of scientific literacy.

Early adolescence, career education and mathematics instruction. The National Council of Teachers of Mathematics is also concerned with career education and its implications for instruction (Applied Management Sciences, Inc., 1977). Its concern parallels that of such groups as the National Education Association, the American Vocational Association and the National Association of Secondary School Principals, which have advocated the integration of career education and the mathematics curriculum. Finn and Brown (1977) summarize the points of view of these organizations. First, mathematics teachers who involve students in career education activities increase awareness of occupations in which mathematics is used. Second, because of the relevancy of career education materials, students' interest in mathematical skills and concepts is increased.

One criticism of mathematics instruction that has been raised by career educators is that increasing emphasis upon abstraction and the derivation of concepts has left little room in the curriculum for practical applications of mathematics in occupational settings (Evans, Hoyt and Mangum, 1973). Highly formal approaches to the subject may be appropriate for the college bound, but may fail to meet the needs of the rest of the population. From the perspective of career education, it is crucial that such applications not be neglected. Insight into the uses of mathematics in computer science, drafting or industrial design may prove motivating to some students who are not excited by abstract mathematical relationships.

Research on occupational stereotypes, mathematics anxiety, and the "mathematics filter" which serves to bar many women and minority persons from many later educational and professional opportunities highlights problems which a career education approach to mathematics could begin to solve.

Early adolescence, career education and social science instruction. Applied Management Sciences (1977) reports the text of a policy statement prepared by the Career Education Study Committee of the National Council for the Social Studies. The Committee conceived of career education as having four major

objectives: (1) to provide students with skills, knowledge and attitudes required in the world of work; (2) to acquaint students with the range of career opportunities and their respective requirements; (3) to acquaint students with the interrelationships of different roles they will assume in society, including the roles of producer and consumer; (4) to reduce undesirable stereotyping of different occupations.

Both value concepts and substantive concepts in the social sciences can contribute much to career education. In addition, fundamental social science skills such as reading, interpretation of charts and graphs, analysis and decision-making are prerequisite to attaining the goals of career education. A fundamental tenet of career education for early adolescents is that content in all disciplines should be presented in ways relevant to students' present and future lives. Evans, Hoyt and Mangum (1973) suggest that in the social sciences this would imply greater attention to economics, the role of employment in family life and society, the interrelationship of different occupations in the social system, and consumer education. Most important, the study of society should include the study of the world of work.

Early adolescence, career education and informal education. There are numerous out-of-school, community-based activities available to early adolescents. Some of these are Boy Scouts, Girl Scouts, Junior Achievement, and 4-H Clubs. These programs often emphasize serving both the social and educational needs of early adolescents. Some of them, like 4-H Clubs, provide skill training but do not have extensive programs for exploration of these areas by younger children. The same pattern is noted in the Boy Scout and Explorer programs (National Institute of Education, 1977). Career exploration is a primary objective of the Explorer program, which serves youth aged fourteen to twenty-one, but is not a major part of the Boy Scout program, which serves younger adolescents. Many of these youth groups are becoming sensitized to the need for a career exploration component in their programs (National Institute of Education, 1977).

Hoyt (1977), with reference to informal or out-of-school activities, emphasizes the falsity of the notion that "education" and "schooling" are the same, or that students learn only during the school day, or learn only from teachers. Informal settings in the community, including business, labor, industry, government and professional spheres, represent an invaluable resource and an indispensable context for the furthering of career education.

Implications

- Infusion of career education concepts into the middle/junior high school mathematics, science, and social science curriculum is critical if the schools are to prepare youth adequately for participation in the world of work.

- Common definitions of the nature and goals of early adolescent career education in the areas of science, mathematics, and social science would facilitate communication about and comparison of early adolescent career education programs.

- Career education in the community as well as the classroom setting is of demonstrated value. Identification of resources in local communities to acquaint students with "real world" applications of abstract science, mathematics and social science concepts is called for.

- The use of community resources can serve to educate and motivate early

adolescents to carry out necessary career exploration and decision-making. An additional objective that should be incorporated into such programs where feasible is the provision of contact for early adolescents with adult role models, countering the tendency toward age segregation in our society.

- Career exploration in early adolescent science, mathematics, and social science instruction is imperative if more youth are to be encouraged to consider careers in these areas.

- In a rapidly changing world, sound preparation in the areas of science, mathematics, and social science is essential to prepare youth for the careers of the future.

Adjunctive and Informal Education

The great developmental diversity of the young adolescent focuses attention on the need at this age level for a variety of educational programs. In this section, educational experiences in settings outside the classroom are considered. Complementing structured classroom settings are the many informal educational settings of day-to-day life. These are all the points at which people pick up facts or ideas just because they seem interesting. They occur at home, at work, and in casual conversation, but zoos and museums, television and other media may contribute most. Intermediate between formal classroom education and informal education are the adjunctive educational settings. These are structured experiences with educational goals, which may supplement or supplant formal schooling. Examples include science clubs and science fairs, as well as complete educational programs in out-of-school settings. These latter adjunctive programs offering alternatives to the classroom setting may be termed action learning programs. Such programs can help to meet the diverse needs of early adolescents.

Action Learning

Smith and Barr (1976) have chronicled a movement since the late 1960's toward educational experiences in alternative settings. The authors point out that diverse educational paths should be provided to meet the diverse needs of students. Increasingly, traditional classroom experiences are being augmented by systematic out-of-school learning experiences, often during normal school hours. The term action learning has come to be applied to these programs. Low-achievers and those disaffected from the school are one important constituency, but many programs also offer bright, independent and highly motivated youth opportunities to pursue their own interests, explore the resources of the community, and engage in community service. Smith and Barr (1976) have listed a number of settings in which action learning programs have been implemented. Among those that appear most conducive to science-related learning experiences are: Learning in the Great Outdoors, Learning in Unfamiliar Cultures (especially relevant to the social sciences), Learning in the Professional Community (e.g., an internship with a medical researcher), Learning from the Past (e.g., at an archeological dig), Learning from Construction and Urban Renewal Projects (e.g., vocational high school students constructing a solar home).

Action learning in science and mathematics. Sherburne (1967) defines as "science youth activities," voluntary extracurricular activities in the areas of science, mathematics or engineering. These activities, which are not considered formal education, have a number of characteristics including: "doing" science rather than hearing about it; they often involve a group of disparate interests that an individual child is drawn toward but that would usually not be treated as a unit in the formal curriculum; they are often long-term interests; they are self-selected, voluntary activities, not requirements; they encourage individual responsibility for learning; they encourage depth in the subject matter beyond what is possible in the curriculum and they provide realistic career guidance. Some of the typical kinds of youth activities Sherburne (1967) discusses are: individual projects (including laboratory work), apprenticeship programs (in labs, industrial settings, or in the field), tours (laboratories, museums, zoos), competitions (science fairs, math contests, junior academy of science), youth clubs (may or may not be school-related) and summer camps. The collection of Contributed Papers from the National Conference on Science Youth Activities (1970) contains reviews of a number of these programs. Areas reviewed included science clubs, science fairs, junior academies of science,

science research by youth, and seminars and lectures. Unfortunately, none of these systematic reviews is focused specifically at the early adolescent period. Data specifically pertinent to early adolescence were available only in the review of science fairs. Highlights of that review (Geiger, 1970) are as follows: In 1963, two percent of all junior high school students were involved in science fairs. Junior high school students' projects were usually collections, classifications or displays, and reflected mainly interest in the life, earth and space sciences. A survey of the Twentieth International Science Fair showed that greatest participation by girls was in the life sciences, including medicine and health. Twenty-two males were in the physics competition, but only one female.

In mathematics specifically, there have been mathematics clubs as well as mathematics competitions at the local, state, and national levels. These informal activities have provided support for students to engage in theoretical, applied, and recreational mathematics. Mu Alpha Theta is an example of such a group at the high school level. Recently, there has been substantial growth in computer clubs, which encourage the development of both programming activities and recreational activities through the use of computer games.

Unfortunately, there is little data available on the impact of these kinds of informal activities on children's skills and attitudes. What little evaluative information there is focuses primarily on high school students, with less attention paid to middle school students.

Action learning in the social sciences. In the area of the social sciences there have been several interesting applications of action learning. For example, the Foxfire experience, described by Smith and Barr (1976), is an example of "doing" social science. Students actually recorded, edited, and published much of the folklore and wisdom of their local region. Other applications in the social sciences include the Georgia Anthropology Project, where students actually do "digs" and other types of anthropological activities. Action learning is used to help students learn about the methodology of sociology and social psychology. Students learn about the techniques of random selection, sampling, and instrument construction, and then conduct an opinion poll. Some of the more popularized examples of action learning are found in the areas of government, city planning and law. Once again most of these applications are found at the high school level rather than the middle school.

Difficulties of implementing action learning activities into the regular school curriculum. Some of the activities listed above can and do occur outside the typical school day. However, as Smith and Barr (1976) point out, more schools are beginning to engage in action learning experiences during the school day. These experiences often require students to move outside the formal institution of the school and engage in activities in the broader community. When schools attempt to include such experiences systematically in their academic programs there are at least two types of problems encountered. First, there are immense scheduling problems to be overcome. Secondly, there is a problem of accreditation for such experiences (Smith and Barr, 1976). Another barrier to implementing such experiences is the lack of information on their impact. If educators had evaluation data accessible to them indicating (even if only provisionally) the quality of some of the action learning programs, then school systems might be more motivated to overcome the scheduling and accreditation problems.

Alternative educational programs as indicators of successful options for middle school students. As stated before, there is no "one" educational program that can fulfill the needs of such a diverse population as middle school youths. One source of information to identify programs that have been successful is the literature on alternative schools. There are a number of alternative schools

that include middle school students. A few examples of such programs are: The Brown School in Jefferson County, Kentucky, which includes grades three through twelve; The St. Paul Open School in St. Paul, Minnesota, which includes kindergarten through grade twelve; The Grand Rapids Zoo School in Grand Rapids, Michigan, which focuses on grade six; the Houston and Dallas Magnet Schools that obviously include grade levels associated with the middle school. These schools incorporate a variety of formal and informal educational programs that could serve to indicate successful approaches to mathematics, science, and social studies for the middle school youth. In addition, these types of alternative schools are frequently evaluated and could help to shed some light on identifying successful programs. It should be noted, however, that there is a real need for more research and evaluation on the middle school and various informal and formal learning programs. It would be fallacious to rely only on the evaluations of alternative school programs since those data reflect the impact of many atypical educational innovations.

Television

By the age of eighteen, the average American youth will have spent fifty percent more time watching television than in school (Siegel, 1977). In helping to develop programs such as NOVA, NSF has already participated in the dissemination of informal educational opportunities that could impact scientific literacy not only among youth but among adults as well. Tressel (1978) points out that NOVA, which is both entertaining and informative, draws an audience of seven million per week. Unfortunately, it is difficult to assess the effectiveness of programs like NOVA in imparting scientific information and increasing science literacy. Apart from disseminating scientific information, programs like NOVA may help to establish the attitude that science can be both entertaining and educational. Once again, more research is needed to determine the impact of such programs on the middle school youth.

Museums and Science - Technology Centers

Other organizations offering important informal educational programs are Science-Technology Centers and/or museums. Many of these institutions are seeking to further public appreciation and understanding of science and technology. As is the case with NOVA, data on number of clients served are available, but evaluation of educational impact is difficult. Also like NOVA, these centers may help to promote the idea that science and mathematics can be entertaining. The fifty-four member institutions of the Association of Science and Technology Centers serve thirty-four million visitors a year, nine million of whom are children. By offering science and mathematics as educational entertainment, such informal education efforts may promote scientific literacy and may lead more young people to consider careers in science.

Implications

- The diversity apparent in early adolescence is often ignored in traditional educational settings. Adjunctive, informal, and alternative educational programs in science, mathematics, and social science may better serve the diverse needs of this group, and should be researched.

- There are a small number of adjunctive, informal and alternative programs directed at early adolescents which could be identified and evaluated, and

information on successful programs disseminated.

- The impact of informal educational opportunities on scientific literacy among early adolescents has not been carefully examined. The effectiveness of NOVA, museums, out-of-school organizations, etc., for increasing scientific literacy have not been evaluated so that additional resources could be targeted most effectively.

- The problem of age segregation could be reduced by community experiences through adjunctive, informal, and career education.

SUMMARY

This document explores various issues relevant to the education of early adolescents. Part I, The Early Adolescent Learner, describes changes in cognition, social cognition, and social contexts during the age span. In Part II, The Learning Context, varous issues in early adolescent education are addressed. Among the topics covered are: school organization; teacher preparation and certification; science, mathematics, and social science curriculum and instruction; group differences in course taking and achievement; career education; and informal and adjunctive education. Important conclusions from each major section of the report are listed below.

The Early Adolescent Learner

Early adolescence, defined as the period from age ten to fifteen, is a significant though neglected period in the life cycle. It is a period of experimentation and re-evaluation, in which movement begins from dependence on adults to interdependence with adults, peers, and younger children. The onset of puberty during this period brings rapid growth and awakening sexual awareness. The average two-year lag between the physical development of males and females during this period, and even greater individual variations, give rise to large differences in the needs and capabilities of youth in this age range.

Cognition and Learning in Early Adolescence

Early adolescence may bring new or increased abilities in abstract reasoning, memorizing, classifying, forming concepts, and other cognitive processes. There is substantial evidence that some, though by no means all, youth attain what Piaget defined as the formal operational level during this period. These new-found abilities prepare some youth for much greater rigor and abstraction in school curricula, but not all youth can be expected to have acquired such abilities, even past the age of fifteen. There is strong support for two conclusions:

- Some early adolescents have attained Piaget's formal operational level, though most have not.
- Diversity in cognitive abilities is characteristic of early adolescents. This diversity has implications for instruction, especially in subject areas requiring precision, abstraction, and logical reasoning skills.
- Further study of the relationship of cognitive style and instructional practices may reveal interactions important to science, mathematics, and social science schooling.

Social Cognition in Early Adolescence

Early adolescence may also bring significant changes in social cognition. These include changes in the way impressions are formed of the self and others, greater sensitivity to non-verbal forms of communication, and increasing awareness of moral and political dilemmas. Impression formation is characterized by greater abstraction, and diminished reliance on superficial characteristics. There is increasing attribution of motives, feelings, and desires to other people. New criteria may be brought to bear in the early adolescent's valuations of persons in society and of societal norms. Youth may begin to take spontaneously the role of

the other during social discourse. While these changes may be substantiated in some adolescents, they do not occur universally. Early adolescence is a period of great diversity in degree of social awareness and social cognition. These increasing capabilities of some early adolescents lead to several conclusions.

- Educators at the middle/junior high school level must contend with diversity among early adolescents in psycho-social development, and the preemptive nature of social and other concerns during this period.

- There has been little research on the relationship of early adolescents' social perception to schooling. For example, the effect of science, mathematics, and social science teachers as role models who apply rational, scientific thinking in solving problems might be researched.

- Due to the preemptive nature of social and other concerns during early adolescence, attention to motivational factors in curriculum materials may be especially important at the middle/junior high school level.

Social Context of Early Adolescence

Two major contextual factors in early adolescence are the adolescent's parents and peers. The interaction of parent and peer values and the tension of conflicting expectations from these two sources may be a significant condition of early adolescence. While the importance of the peer group increases during early adolescence, research suggests that for most youth parents remain the principal source of values in choice areas perceived as most difficult or important. Parental behavior may have critical consequences for early adolescent youth. Different researchers have emphasized the importance of parental commitment, of consistent and rational discipline, and of parents as role models during this period. Changes in the importance of different social context support three conclusions relevant to education for this age range:

- Early adolescence is a period during which peers begin to become a more significant source of values. Science, mathematics, and social science achievement may be more esteemed throughout this period, if it is fostered as a value of the peer culture. The furthering of such values in the context of adult-led youth clubs and organizations, as well as the context of youth-initiated activities, should be explored.

- Teachers would benefit from information on changes that occur during early adolescence in the significance of different social contexts (adults, parents, and peers) as sources of values. In particular, their significance as role models for scientific, rational thought should be researched.

- More opportunities might be provided for early adolescents to explore science, mathematics, and social science in a variety of settings that provide for interaction with individuals of different ages and ethnic backgrounds.

The Learning Context

Early adolescence is a period of special challenge to the schools. The period brings rapid physical growth, the onset of puberty, the beginning of new cognitive abilities, participation in a broader social context, increasing importance of peer affiliations, and greater sensitivity to the political and moral

aspects of situations and events. In response to these changes, the schools are called upon to offer increased diversity in both curricula and instructional approaches. Meaningful, relevant learning experiences should be provided, including experiences in settings outside the school walls.

Formal Public School Instruction for Early Adolescents

The two major types of schools for early adolescents are junior high schools and middle schools. They can be distinguished on the basis of the range of age and grade levels served. The traditional junior high school serves grades seven through nine. Middle schools typically include grades six through eight, but sometimes include grades as low as five or as high as nine. There is little evidence of any systematic differences between middle and junior high school curricula or instructional practices for youth at a given grade level. Research has failed to establish the superiority of either organization.

Science, mathematics and social science curricula at this level are typically "watered down" versions of high school curricula. Textbook-based general science courses are taken by most middle/junior high school students. Computation, fractions, and decimals are still at the core of many mathematics programs for this age span, but geometry and algebra are also found, the latter often being introduced as early as the eighth grade. History, geography, and studies of other cultures have been the most typical social studies offerings during this period. Few curricula have systematically incorporated significant content from the social sciences.

Four important conclusions are as follows:

- There are differences in the philosophy of the middle school and the junior high school, but the practical distinction between the two is unclear. Curriculum may be quite similar in the two settings. The variability among schools is greater than the difference between the two school types. Given the lack of distinction between middle schools and junior high schools, the failure of research to establish the superiority of one or the other is not suprising.

- Early adolescence is a period marked by dramatic physical, cognitive and emotional changes. For most youth, one or more transitions in patterns of school organization will also occur during this period. Along with these organizational changes (e.g. moving from the elementary school into the middle/junior high school) comes an increase in the rigor demanded by science, mathematics, and social science instruction. The coordination of changes within the learner and changes in instruction is an area of needed research.

- The nature and purpose of science, mathematics, and social science instruction at the middle/junior high school level needs to be evaluated in the context of instruction from grades K through twelve and beyond. The provision of relevant, motivating instruction at this level may be critical in encouraging further study and ultimate career selections in these areas.

- Research on middle versus junior high school organizations does not consistently favor either type of school. This suggests that a more useful focus for research would be the outcomes of specific curricula and/or instructional practices, regardless of the type of school in which they are implemented.

Teacher Preparation and Certification

Most teachers at the middle/junior high school level were trained as either elementary or secondary school teachers, and many have no strong identification to the intermediate grades. Published statistics indicate that few degrees are awarded in junior high school education. However, since 1968 a significant number of states have taken action on certification requirements for middle school teaching, and a number of institutions are now training teachers specifically to work in middle schools.

- The unique educational needs of early adolescents call for teaching professionals especially interested in and trained to work with this age span. The normal, healthy majority of early adolescents as well as those with special difficulties should be served by persons with such training. Historically, such training has not been widely available, and most teachers have specialized in either elementary or secondary school instruction.

- Preservice and inservice programs may be especially helpful to middle/junior high school science, mathematics and social science teachers who were not trained specifically to work at the early adolescent level.

Staff Support

Recent cutbacks in schooling have led to fewer state-wide subject area coordinators and school or district level curriculum supervisors. Most science, mathematics and social science teachers in grades seven through nine relied upon other teachers as a major source of information about curriculum materials. In a recent survey, many middle-school science teachers expressed a desire for more workshops and inservice programs. These data all suggest a need among middle/junior high school teachers for current information on new curricula and instructional materials. The conclusion is as follows:

- There is a critical lack of current information on curriculum among middle/junior high school science, social science and mathematics teachers. As traditional information sources such as curriculum supervisors and statewide coordinators have become less common, the importance of curriculum information dissemination via teacher centers, workshops, and inservice education activities has increased. Only limited data are presently available on perceived teacher needs and information sources specific to the early adolescent period.

Science Instruction for Early Adolescents

Science instruction for some early adolescents can make more effective use of logical operations, critical thinking and heuristics than instruction for younger children, although a large proportion of early adolescents are still at the concrete operational level. Studies of direct instruction in logical abilities have shown that application of these abilities in specific situations can be taught, especially to students at the eighth grade level or above.

Different studies have consistently shown a decline in the attitudes of junior high/middle school students toward science. There is strong evidence for this phenomenon, and it is cause for concern.

Teacher preparation for middle/junior high school science instruction also gives cause for concern. Science teachers at this level tend to regard their own training and subject matter information as much less adequate than do senior high school science teachers.

Conclusions are as follows:

- Research on the Piagetian model indicates that many early adolescents are not at the formal operational level. Reliance of current science curricula on formal operational abilities should be investigated. New curricula or supplementary materials may be indicated.

- Numerous instructional sequences have been used with apparent success to teach specific logical operations or analytical procedures. These methods appear to be most effective with children at the eighth grade level or above. The lower limit of age for effective instruction of this type should be determined, and ways to facilitate transfer to new materials should be investigated.

- Teacher preparation for middle/junior high school science is an area of critical concern. Studies indicate that junior high school teachers believe their science content and methodology to be inadequate.

- Deteriorating attitudes toward science between the sixth and tenth grades indicate that early adolescence is a critical period in maintaining and/or developing positive attitudes toward science. The possible linkage between increasing rigor and/or decreasing relevance in science instruction and increasing student dislike should be researched.

Mathematics Instruction for Early Adolescents

The formal operational abilities which emerge for some youth during early adolescence are important for mathematics instruction. Some bright fifth and sixth graders have been shown to be as capable as many college students in learning mathematical logic. On the other hand, many early adolescents are still at the concrete operational level, and may not profit from instruction that is too abstract.

Research on instructional methods and teaching has been fragmentary, as most investigators have focused on small content segments at specific grade levels. This research suggests that problem solving is facilitated when problems are presented in "relevant" contexts, but the overall superiority of one instructional approach to another has rarely been established. One general approach which appears promising, especially in highly structured content areas like mathematics, is Bloom's mastery learning.

Research on attitudes toward mathematics has shown a strong relationship between mathematics attitudes and achievement at the middle/junior high school level. Sex differences in attitudes become apparent during this age span, with boys liking mathematics better and earning higher achievement test scores than girls.

- Research based on the Piagetian model clearly indicates that many early adolescents are not at the formal operational level. Existing curricula should be examined to determine the extent of their reliance on formal operations in the Piagetian sense, and either supplementary instructional materials or new curricula may need to be devised.

- Most research studies involving early adolescents have focused on only one grade level. Comprehensive investigations of the entire middle/junior high school period are called for.

- Significant sex differences in attitudes toward mathematics emerge during early adolescence. The middle/junior high school years appear to be a critical period for intervention if "mathematics anxiety" and lower achievement scores among females are to be countered.

Social Science Instruction for Early Adolescents

Few courses designated specifically as "social science" are offered at the middle/junior high school level. Thus there is substantially more information available on early adolescent social studies instruction than social science instruction. What research is available on social science instruction has been largely inconclusive. This may be due to a lack of precision in describing the instructional treatments studied and to the brief duration of most such treatments. Many of these studies also suffer from limited generalizability as they focus on only one or two grades and fail to provide comprehensive reviews of the entire range of grades. There is a developing research literature relating cognitive development and social science content. Although the work of some developmental psychologists has provided evidence of differences between concrete and formal thinkers with regard to concepts such as freedom or justice, few implications of such findings have been explored in the classroom.

Several conclusions are as follows:

- Few courses designated specifically as "social science" are offered at the middle/junior high school level.

- Most research studies involving early adolescents have focused on only one grade level. Comprehensive investigations of the entire middle/junior high school grade range are called for.

- Little research relating early adolescent cognitive development to ability to master social science content has appeared. Research that isolates abilities required for social science instruction is needed. Such research might draw upon the kinds of abilities identified by developmental psychologists.

- Diversity in level of cognitive development may have implications for social science instruction. If formal thinkers can master such abstract concepts as freedom or justice, while concrete thinkers cannot, differential instruction might be indicated.

Group Differences in Early Adolescent Science, Mathematics, and Social Science Course Taking and Achievement

Psychologists have documented numerous differences betwen the performance of males and females but it is unclear whether most of these arise from different patterns of abilities, different social expectations, or both. There is a large overlap between score distributions for males and females on virtually all measures.

Patterns of performance across geographic regions, racial/ethnic groups and socioeconomic strataare similar for science achievement to those in most other academic areas: Achievement is lower in the southeast, in minority groups, and in disadvantaged urban communities.

An unfortunate pattern that often begins during the middle/junior high school years, especially among women and minorities, is as follows. Due to sex or race stereotypes, "math anxiety", or perceptions of mathematics courses as difficult, students avoid advanced mathematics sequences. Without such coursework, they then lack the prerequisites for mathematically oriented high school science courses, e.g. physics and chemistry. Finally, lack of adequate science and mathematics preparation virtually precludes post-secondary training in many areas, and also limits the job opportunities of students who do not elect to go on to college. The extent of this problem is shown by data on differential course enrollments of males and females, and of various racial/ethnic groups.

Conclusions to be drawn from these findings are as follows:

- Sex and race stereotyping, "math anxiety", and lack of awareness of the importance of mathematics lead many students to avoid necessary courses beginning with algebra in the eighth or ninth grade. This problem is especially acute among women and minorities.

- Students who avoid high school mathematics sequences typically do not have the mathematical skills required for high school science courses such as chemistry and physics. Such avoidance often begins in early adolescence. More students might be encouraged to take such courses if development of necessary mathematics skills were incorporated into course content.

- Science and mathematics courses beyond the middle/junior high school level are necessary for many careers and for a high level of science literacy.

- Early adolescents and their parents need to be alerted to the importance of science and mathematics course taking at the middle/junior high school level.

Curricula for Early Adolescent Science, Mathematics, and Social Science Instruction

A comprehensive curriculum for the middle/junior high school in science, mathematics, social science, or some combination involving these subject areas would include many elements. It would offer a course of study spanning several school years, organized according to some consistent educational philosophy and operationalized in a range of instructional materials. To be effective, it would be accompanied by materials for teacher preservice programs and/or inservice programs, or other provision would be made for sufficient staff preparation to permit adequate implementation. While isolated materials are available from many sources which are suitable for use with early adolescents, few comprehensive middle/junior high school curricula are available. Most available materials for use with early adolescents are part of either elementary or secondary school curriculum series, or are included in series spanning grades K through 12. Tabulations of federally funded projects involving research on adolescence suggest that much work is ongoing, and that the majority of ongoing projects involve some form of educational curriculum. Available data do not indicate how much of this work is specific to the early adolescent period, however. No source was located which systematically surveyed the effectiveness of available middle/junior high school science, mathematics, or social science curricula. In the absence of such a review, it is unclear whether resources would be better channeled into curriculum development or dissemination.

Conclusions are as follows:

- Relatively few available curricula in science, mathematics, and social science

are focused specifically on the period of early adolescence. Rather this age span is often covered at the end of an elementary curriculum series or at the beginning of a secondary series.

- Information on the scope, suitability and effectiveness of existing curricula should be compiled.

Career Education for the Early Adolescent

Preparing youth to participate in the labor force is increasingly viewed as a responsibility of the schools. To further this goal among others, writers on career education have developed models which span the years from kindergarten into adulthood. Typically, the middle/junior high school years are viewed as a time for career exploration, studying different occupations and different applications of skills and information learned in school. The actual content of career education programs varies widely, and research has been hampered by lack of consensus on a definition. Some of the instructional practices which have been used with early adolescents are interviews of workers, research projects by students, class discussions about the world of work, hands-on activities in which students try performing tasks a worker would, field trips, "shadowing" by students of an adult at work, and role-playing. Capitalizing on community resources in providing experiences outside of the classroom setting is generally encouraged. Most evaluations have reported some benefits associated with career education curricula, most typically gains in information about specific occupations and more favorable attitudes toward work.

Conclusions concerning career education are as follows:

- Infusion of career education concepts into the middle/junior high school mathematics, science, and social science curriculum may facilitate the preparation of youth for participation in the world of work.

- The use of community resources can acquaint students with "real world" applications of abstract science, mathematics, and social science concepts, can provide contact with adult role models in occupational settings, and may help motivate youth to carry out necessary career exploration and decision-making.

- Career exploration in early adolescent science, mathematics, and social science instruction might encourage more youth to consider careers in these areas.

Adjunctive and Informal Education

The great diversity among early adolescents implies a need at this age level for a variety of educational programs. These may include educational experiences in settings outside the classroom. Complementing structured classroom settings are the many informal educational settings of day-to-day life. It is in these settings that people acquire facts or ideas just because they seem interesting. They occur at home, at work, and in casual conversation, but zoos and museums, television and other media may contribute most. Intermediate between the formal educational setting of the classroom and informal settings of daily experience are adjunctive educational settings. These are the settings of structured experiences, with educational goals, which either supplement or supplant formal classroom

instruction. Examples include science clubs and science fairs, as well as complete educational programs in out-of-school settings. These latter adjunctive programs, offering alternatives to the classroom setting, may be termed action learning programs.

Action-learning programs may offer attractive alternatives not only to youth disaffected from the school, but also to independent and highly motivated youth, who wish to pursue their own interests, explore the resources of the community, or engage in community service.

Examples of other adjunctive activities include individual student projects, tours (e.g. of laboratories, museums, or zoos), science fairs, mathematics contests, and computer clubs. Problems of scheduling and accreditation often preclude such activities in the course of the regular school day. In addition, such activities are difficult to evaluate systematically. "Hard data" on effectiveness of such activities might encourage their adaptation in more middle/junior high schools.

Informal educational opportunities are typically available to persons of all ages. They are provided systematically by television series such as NOVA, as well as by exhibits in Science-Technology Centers, zoos, and museums. By offering science and mathematics as educational entertainment, such informal education efforts promote scientific literacy, and may lead more young people to consider careers in science.

The following may be concluded concerning adjunctive and informal education:

- The diversity apparent in early adolescence is often ignored in traditional educational settings. Adjunctive, informal, and alternative educational programs in science, mathematics, and social science may better serve the diverse needs of this group.

- There are a small number of adjunctive, informal and alternative programs directed at early adolescents which could be identified and evaluated, and information on successful programs disseminated.

- The impact of informal educational opportunities on scientific literacy among early adolescents has not been carefully examined. Evaluations of the effectiveness of NOVA, museums, and out-of-school organizations for increasing scientific literacy could inform policy decisions for further development and/or for dissemination.

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Note 1. Backler, A. L. Personal communications, September 29, 1978 and October 4, 1978.

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